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FINAL REPORT

POTENTIAL EFFECTS OF INCREASED WATER LEVELS ON FLORA AND FAUNA AT HORSESHOE LAKE, ALEXANDER COUNTY, ILLINOIS

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Project Period: February 15, 1993 through May 15, 1994

Submitted to:

Division of Natural Heritage
Illinois Department of Conservation
Lincoln Tower Plaza, 524 South Second Street
Springfield, Illinois 62701-1787

May 20, 1994

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TABLE OF CONTENTS

LIST OF FIGURES iii

LIST OF TABLES vii

JOB 1. REVIEW OF LITERATURE 1-1

JOB 2. VEGETATION MAPPING

PART ONE (MAPPING) 2-1

PART TWO (ASSESSMENT) 2-5

APPENDIX 2-7

JOB 3. FOREST COMMUNITY DESCRIPTION

PART ONE (SURVEY) 3-1

PART TWO (ASSESSMENT) 3-5

JOB 4. PLANT COMMUNITIES

PART ONE (SURVEY) 4-1

PART TWO (ASSESSMENT) 4-8

APPENDIX 4-17

JOB 5. HERPETOFAUNA

PART ONE (SURVEY) 5-1

PART TWO (ASSESSMENT) 5-15

JOB 6. AVIAN COMMUNITY SURVEYS

PART ONE (SURVEY) 6-1

PART TWO (ASSESSMENT) 6-5

APPENDICES 6-35

JOB 7. FISH, UNIONID MUSSEL, CRAYFISH, AND SHRIMP SPECIES

PART ONE (SURVEY) 7-1

PART TWO (ASSESSMENT) 7-17

JOB 8. MAMMALS

PART ONE (SURVEY)..... 8-1

PART TWO (ASSESSMENT)..... 8-13

SUMMARY OF ASSESSMENTS OF IMPACT 9-1

LIST OF FIGURES

FIGURE 1-1. Location map for Horseshoe Lake, Alexander County, Illinois (modified from Lee et al. 1986) 1-7

FIGURE 1-2. Location of primary macrophyte beds in Horseshoe Lake, Alexander County, Illinois, in 1984 (from Lee et al. 1986) 1-8

FIGURE 1-3. Siltation rates in Horseshoe Lake, Alexander County, Illinois, from 1951 to 1984 (from Lee et al. 1986) 1-9

FIGURE 1-4. Location of Inland Woods and Island Woods Nature Preserves at Horseshoe Lake, Alexander County, Illinois 1-10

FIGURE 3-1. Contiguous tracts of bottomland forest at Horseshoe Lake CA 3-27

FIGURE 4-1. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-11

FIGURE 4-2. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-12

FIGURE 4-3. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-13

FIGURE 4-4. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-14

FIGURE 4-5. Site locations where Ptilimnium costatum threatened, or rare plants was found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-15

FIGURE 4-6. Site locations where 3 species of

endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993 4-16

FIGURE 5-1. Cricket frog, Acris crepitans (above); American toad, Bufo americanus (below) 5-24

FIGURE 5-2. Fowler's toad, Bufo woodhousii (above); Cope's gray treefrog, Hyla chrysoscelis (below) 5-25

FIGURE 5-3. Green treefrog, Hyla cinerea (above); spring peeper, Pseudacris crucifer (below) 5-26

FIGURE 5-4. Upland chorus frog, Pseudacris feriarum (above); Illinois chorus frog, Pseudacris streckeri (below) 5-27

FIGURE 5-5. Plains leopard frog, Rana blairi (above); bullfrog, Rana catesbeiana (below) 5-28

FIGURE 5-6. Green frog, Rana clamitans (above); southern leopard frog, Rana sphenocephala (below) ... 5-29

FIGURE 5-7. Eastern spadefoot, Scaphiopus holbrookii (above); spotted salamander, Ambystoma maculatum (below) 5-30

FIGURE 5-8. Marbled salamander, Ambystoma opacum (above); mole salamander, Ambystoma talpoideum (below) 5-31

FIGURE 5-9. Smallmouth salamander, Ambystoma texanum (above); Plethodon glutinosus (below) 5-32

FIGURE 5-10. Lesser siren, Siren intermedia (above); snapping turtle, Chelydra serpentina (below) 5-33

FIGURE 5-11. Painted turtle, Chrysemys picta (above); common musk turtle, Sternotherus odoratus (below) 5-34

FIGURE 5-12. Eastern box turtle, Terrapene carolina (above); slider, Trachemys scripta (below) 5-35

FIGURE 5-13. Five-lined skink, Eumeces fasciatus (above); broadhead skink, Eumeces laticeps (below) 5-36

FIGURE 5-14. Worm snake, Carphophis amoenus (above); racer, Coluber constrictor (below) 5-37

FIGURE 5-15. Rat snake, Elaphe obsoleta (above); common kingsnake, Lampropeltis getula (below) 5-38

FIGURE 5-16. Plainbelly water snake, Nerodia erythrogaster (above); diamondback water snake, Nerodia rhombifer (below) 5-39

FIGURE 5-17. Rough green snake, Opheodrys aestivus (above); brown snake, Storeria dekayi (below) 5-40

FIGURE 5-18. Redbelly snake, Storeria occipito-maculata (above); western ribbon snake, Thamnophis proximus (below) 5-41

FIGURE 5-19. Common garter snake, Thamnophis sirtalis 5-42

FIGURE 5-20. Sites where Illinois chorus frogs were seen on roads (solid dots) and confirmed breeding ponds (circled dots) during 1993-1994 5-43

FIGURE 6-1. Locations of 45 census stops on 6 transects, and 10 qualitative census stops where detections of avian species were recorded during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-25

FIGURE 6-2. Census stops where little blue herons and great egrets were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-26

FIGURE 6-3. Census stops where snowy egrets and black-crowned night herons were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-26

FIGURE 6-4. Census stops where Mississippi kites and red-shouldered hawks were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-28

FIGURE 6-5. Census stops where bald eagles and loggerhead shrikes were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-29

FIGURE 6-6. Census stops where hooded mergansers

and broad-winged hawks were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-30

FIGURE 6-7. Census stops where wood thrushes and cerulean warblers were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-31

FIGURE 6-8. Census stops where Acadian flycatchers and dickcissels were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-32

FIGURE 6-9. Census stops where prothonotary warblers and grasshopper sparrows were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-33

FIGURE 6-10. Census stops where yellow-throated warblers and brown-headed cowbirds were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993 6-10

FIGURE 7-1. Sampling locations during the 1993-1994 fish surveys of the Horseshoe Lake watershed, Alexander County, Illinois 7-38

FIGURE 7-2. Sites of occurrence for the State Endangered cypress minnow (Hybognathus hayi) in the Horseshoe Lake watershed, Alexander County, Illinois, 1993-1994 7-39

FIGURE 7-3. Sites of occurrence for the State Endangered oxbow crayfish (Orconectes lancifer) in the Horseshoe Lake watershed, Alexander County, Illinois, 1993-1994 7-40

FIGURE 8-1. Locations of small mammal trapping sites operated on Horseshoe Lake Conservation Area from May through July 1993 8-24

FIGURE 8-2. Location of sites on Horseshoe Lake Conservation Area where mist-netting for bats was conducted from May through September 1993 8-25

LIST OF TABLES

TABLE 2-1. Summary statistics of general vegetation communities and land use features within Horseshoe Lake Conservation Area, summer 1993 2-6

TABLE 3-1. List of tree species found within 90 400 m^2 quadrates located in 7 bottomland hardwood forest tracts at Horseshoe Lake CA in southern Illinois during fall 1993 3-9

TABLE 3-2. Density and basal area of overstory tree species in forest tracts at Horseshoe Lake Conservation Area in southern Illinois during 1993 3-12

TABLE 3-3. Density and basal area of tree species of the sapling layer in forest tracts at Horseshoe Lake Conservation Area in southern Illinois during 1993 3-22

TABLE 5-1. Relative abundances of species of amphibians and reptiles observed in the Horseshoe Lake area during the period April 1993 - April 1994 5-21

TABLE 6-1. Total numbers and percent species composition of resident bird species detected on individual transects and qualitative census stops at Horseshoe Lake Conservation Area during May and June 1993 6-13

TABLE 6-2. Non-resident species seen or heard at Horseshoe Lake Conservation Area, May-June 1993 6-17

TABLE 6-3. Community type, species richness, and diversity recorded at census stops on transect 1 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-18

TABLE 6-4. Community type, species richness, and diversity recorded at census stops on transect 2 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-19

TABLE 6-5. Community type, species richness, and diversity recorded at census stops on transect 3 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-20

TABLE 6-6. Community type, species richness, and diversity recorded at census stops on transect 4 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-21

TABLE 6-7. Community type, species richness, and diversity recorded at census stops on transect 5 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-22

TABLE 6-8. Community type, species richness, and diversity recorded at census stops on transect 6 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-23

TABLE 6-9. Community type, species richness, and diversity recorded at qualitative stops during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993 6-24

TABLE 7-1. Fishes recorded by electrofishing from Horseshoe Lake, Alexander County, Illinois, 1993 7-22

TABLE 7-2. Fishes recorded by electrofishing from Horseshoe Lake, Alexander County, Illinois, spring, 1994 7-24

TABLE 7-3. Fishes recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, 1993 7-26

TABLE 7-4. Fishes recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, spring, 1994 7-30

TABLE 7-5. Fishes recorded previously from the Horseshoe Lake region, Alexander County, Illinois, but not found during the 1993-1994 survey 7-34

TABLE 7-6. Unionid mussels found in the Horseshoe Lake area, Alexander County, Illinois, 1993-1994 7-35

TABLE 7-7. Crayfishes and shrimps (Decapoda) recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, 1993 7-36

TABLE 7-8. Crayfishes and shrimps (Decapoda) recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, spring 1994 7-37

TABLE 8-1. Terrestrial small mammals taken on seven sites on Horseshoe Lake Conservation Area from 27 May through 29 July 1993 8-18

TABLE 8-2. Site-specific number of captures, number of species captured, capture frequencies, and diversity indices for small mammals taken on seven sites on Horseshoe Lake Conservation Area from

May through July 1993 8-19

TABLE 8-3. Totl number of bats mist-netted at six locations on Horseshoe Lake Conservation Area from 7 May through 10 September 1993 8-20

TABLE 8-4. Date, time, and site captured, sex, age, reproductive condition, and ambient air temperature at time of capture for seven species of bats mist-netted from May through September 1993 on Horseshoe Lake Conservation Area 8-21

JOB 1: REVIEW OF LITERATURE ON HORSESHOE LAKE, ALEXANDER COUNTY, ILLINOIS

The Horseshoe Lake Conservation Area is located in the floodplain of the Mississippi River in Alexander County, Illinois. The area occupies 9,141 acres [3,702 hectares] (this report), which includes the 1,965-acre [796-hectare] Horseshoe Lake (this report). It is located south of Olive Branch and occupies parts of 12 sections in T16S, R2W (Figure 1-1). The outline of the lake, which sometimes resembles a horseshoe, probably suggested the name. The lake was formed from an old meander of the Mississippi River, which is now less than two miles [3.22 km] at the closest point to the west; the age of the lake is about 6,000 years (Bogner et al. 1985). The east arm of the lake is approximately 3.75 miles [6.03 km] long and 0.25 miles [0.40 km] across. To the northwest is a mixture of small lakes and swamp areas. Stretching from the northwest are two arms. One trends southeastward, is about 2.75 miles [4.42 km] long and 0.25 miles [0.40 km] across, and joins the east arm about 0.5 miles [0.80 km] north of the southern extremity of the lake. Between this, the central arm, and the east arm is an island about 2 miles [3.22 km] long and 0.5 miles [0.80km] wide. The other arm, the western, trends southward for 0.5 miles [0.80 km], where a levee impounds the water and prevents its flow to the old lake bed that stretches on farther to the south. A dam and spillway at the south end of the eastern and central arms control to some extent the water level of the lake. Overflow at the dam enters Lake Creek and flows northeastward into the Cache River (Evers and Page 1977). Lee et al. (1986) stated that the primary sources of recharge for this oxbow lake are from tributary streams [viz., Black and Pigeon Roost creeks] that drain 13.64 square miles [35.33 square km] of watershed and from flooding from backwaters of the Mississippi River every two or three years. Evers and Page (1977) noted that during dry seasons, several large wells augment this supply. The striking feature of the lake is the number of bald cypress (Taxodium distichum) and tupelo gum (Nyssa aquatica) that grow out into the water. Approximately 40% of the surface is at least partially shaded by these trees.

Horseshoe Lake Conservation Area lies within the Mississippi Bottomlands Section of the Coastal Plain Division of Illinois (Schwegman et al. 1973). Numerous natural plant communities occur within the boundaries of the Conservation Area, including cypress-tupelo swamps, mesic and bottomland forests, emergent wetlands, open lakes, and ponds. In 1977, the native vegetation of the area was classified as 1) forest and 2) aquatic and semiaquatic (Evers and Page 1977). On the island and some of the land to the west of the central arm were cultivated fields of corn, sunflowers, and soybeans. Crops produced in these fields provide food for migrating

Canada geese. Floating on or near the surface of the lake are several duckweeds (Wolfia spp.) and the mosquito fern (Azolla mexicana). In 1984, American lotus (Nelumbo lutea) and coontail or hornwart (Ceratophyllum demersum) were the dominant macrophytes (Lee et al. 1986). The majority of the beds were located in the east section of the lake (Figure 1-2). Coontail also grows in patches in other areas of the lake within 5 feet [1.52 m] of the shoreline. Other plants of the shoreline include arrowhead (Sagittaria latifolia), pickerel weed (Pontederia cordata) , primrose willow (Jussiaea decurrens), buttonbush (Cephalanthus occidentalis), swamp privet (Forestiera acuminata), swamp cottonwood (Populus heterophylla), box elder (Acer negundo), Drummond's maple (Acer rubrum var. drummondii), and numerous herbs (Huston 1972, Evers and Page 1977). Algae counts tend to be above 500 cts/ml. Diatoms tend to dominate in May followed by green algae in June and July and blue-green algae later in the summer. Phytoplankton diversity and productivity was reviewed by Grady (1985).

Prior to 1927, when a dam and spillway were constructed, the lake had existed as a shallow cypress swamp, portions of which regularly dried up during July and August; it never, however, dried out completely (Bogner et al. 1985). The Miller City arm was formed prior to 1927 and was present off and on until at least 1950. According to Thompson and Bennett (1938) the dam holding Horseshoe Lake washed out in 1930. The lake drained and lay completely dry for a year. Apparently the only water left was in the dredge ditch (i.e., Black Creek) to the north of the lake. A permanent dam of concrete with deep foundations was built in 1931. Rains in late summer and early fall of that year partially filled the lake. A 2-foot [.61 m] high retaining wall was added to the dam in 1933. It extended east and west from the existing spillway wing walls (Bogner et al. 1985). The controllable spillway was replaced by a fixed concrete overflow spillway in 1939 (IDOC 1972). Following completion of the 1939 spillway and dam construction, the lake level was approximately 4.5 feet [1.37 m] higher than the uncontrolled, pre-development lake. The increase in water level inundated approximately 640 acres [259 hectares] of adjacent low lands. In 1963, IDOC dredged the Black Creek channel to within 500 feet [152 m] of the lake. The last 500 feet [152 m] of dense vegetation and shallow water was then blasted open and dredged to promote better drainage and to provide continued access to the lake for property owners along this stretch of the creek (Lee 1993). In 1993 the dam was reinforced and two water control gates were installed. The spillway elevation remained the same.

Until 1939 floodwater entered the lake by overland flow from the Mississippi River and as backwater over the spillway (Bogner et al. 1985). The Fayville Levee on the Mississippi

River was completed in 1969, after which it effectively prevented overland flow to the lake. Local residents attribute the aggregation of the Black Creek delta and general siltation of the area to the completion of the levee (Lee 1993). The Fayville Levee was breached southwest of Miller City during the 1993 flood on 15 July and again on 13 April 1994. A brief review of the flood and its impact on Horseshoe Lake was provided by Crane (1994).

Horseshoe Lake is a shallow eutrophic lake characterized by a high sedimentation rate (Lee et al. 1986). During the period from 1951 to 1984 the lake has been filling at an average rate of 0.47 inches [1.19 cm] per year (Figure 1-3). It has a trap efficiency of 94%. The mean depth of the lake is 2.96 feet [.90 m] and the maximum depth is less than 5.0 feet [1.52 m].

From March 1984 to March 1985, Lee et al. (1986) took monthly dissolved oxygen and temperature samples at five locations in the lake. Temperatures were uniform from top to bottom and during the summer months water was supersaturated with dissolved oxygen near the surface and anoxic near the bottom. No samples were taken in January or February. The lake's sediment oxygen demand rates are high. In 1984, they ranged from 4.04 to 6.58 mg per square meter per day at 25 C. Average volatile fraction of suspended solids averaged 68%, which indicates very high organic enrichment (Lee et al. 1986). Mean dissolved phosphorous values ranged from 0.03 to 0.06 mg/l; however, inorganic nitrogen was below 0.3 mg/l. All of these parameters along with its shallow average depth, indicate that the lake is very eutrophic and, therefore, could be subject to low oxygen levels in the winter under ice and snow cover as well as in the summer.

Lake Creek is a short (about 4 miles[6.43 km] long), low-gradient tributary to Cache River characterized by great annual variation in flow; it drains, in part, Horseshoe Lake. The two-mile-long [3.22 km] stretch of Lake Creek extends from its origin below Horseshoe Lake spillway into E sec. 14, T16S, R2W, where it empties into an extensive, wooded swampland southwest of a partial levee, thence to the Cache River. It is subject to annual spring backwater flooding from the Cache and Mississippi rivers and, during the late summer, occasionally dries up below the spillway. When flow is sufficient, pools up to five feet [1.52 m] deep are connected by raceways and riffles. The bottom of the spillway pool is a mixture of gravel, sand, mud and organic debris, varying anually from five feet [1.52 m] deep and full of logs and trash, to dry. Roughly the upper third of the creek is a series of pools (up to five feet [1.52 m] deep) and raceways (up to knee deep) with a bottom of firm mud covered by organic debris and bald cypress knees (Cummings et al. 1984). The mid-section of the creek seems more pooled and constantly turbid with a bottom of deep (2-3 feet [.61-

.91 m]) muck. Young hardwood forest borders most of the creek and separates much of it from cultivated fields, but adjacent to the creek at the spillway and at its northeast end, are extensive floodplain forest and swampland.

The animal life at Horseshoe Lake includes numerous representatives of the Coastal Plain fauna, making it one of the most unique areas in Illinois. Amphibian species rarely found elsewhere in the state include the mole salamander (Ambystoma talpoideum), eastern spadefoot (Scaphiopus holbrookii), bird-voiced treefrog (Hyla avivoca), and green treefrog (Hyla cinerea). Rare reptiles are the broad-banded water snake (Nerodia fasciata), the Mississippi green water snake (Nerodia cyclopion), mud snake (Farancia abacura), cottonmouth (Agkistrodon piscivorus), and river cooter (Pseudemys concinna) (Smith 1961). Other rare animals at Horseshoe Lake are Rafinesque's big-eared bat (Plecotus rafinesqueii) (Smith and Parmalee 1954), southeastern myotis (Myotis austroriparius), southeastern shrew (Sorex longirostris), marsh rice rat (Oryzomys palustris) (Hoffmeister 1989), and bobcat (Felis rufus) (Klimstra and Roseberry 1969). The bald eagle (Haliaeetus leucocephalus) historically nested on Horseshoe Lake and records for Swainson's warbler (Limnothlypis swainsonii) are available from the area (Bohlen 1989). The oxbow crayfish (Orconectes lancifer) is known only from Horseshoe Lake (Page 1985). Unusual fishes include the spotted gar (Lepisosteus oculatus), pugnose minnow (Opsopoeodus emiliae), and brown bullhead (Ameiurus nebulosus) (Smith 1979).

Evers and Page (1977) provided a list of rare insects at Horseshoe Lake including a thrips, Scirtothrips taxodii, and plant bugs, Pilophorus taxodii and Phytocoris taxodii, living on cypress trees; a thrips, Heterothrips aesculi, living on buckeye; an earwig, Vostox brunneipennis; and two species of scorpionflies, Boreus brumalis and Bittacus punctiger.

According to IDOC (1972), the management objectives for the Horseshoe Lake area are: 1) to provide a winter refuge for the Illinois flock of the Mississippi Valley population of the migratory Canada goose (Branta canadensis); 2) to preserve the natural character of the area; 3) to provide hunting, sightseeing, camping, and fishing; 4) to promote forest management; and 5) to preserve Horseshoe Lake Forest and the Horseshoe Lake Island Woods and Inland Woods Nature Preserves (Figure 1-4). Currently, more than 200,000 geese overwinter in the Horseshoe Lake Conservation Area.

Other pertinent literature is reviewed in the appropriate job.

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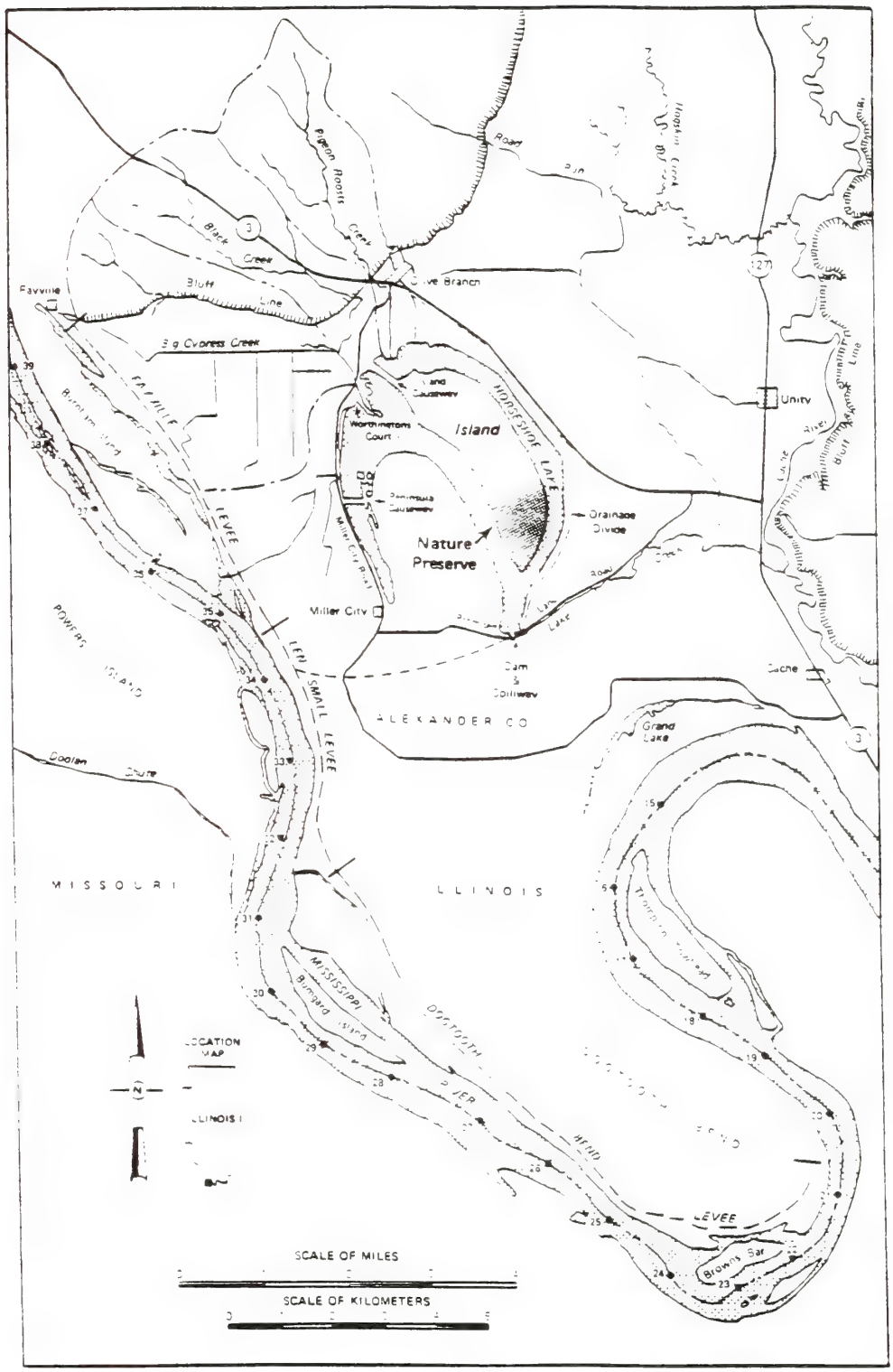


FIGURE 1-1. Location map for Horseshoe Lake, Alexander County, Illinois (modified from Lee et al. 1986)

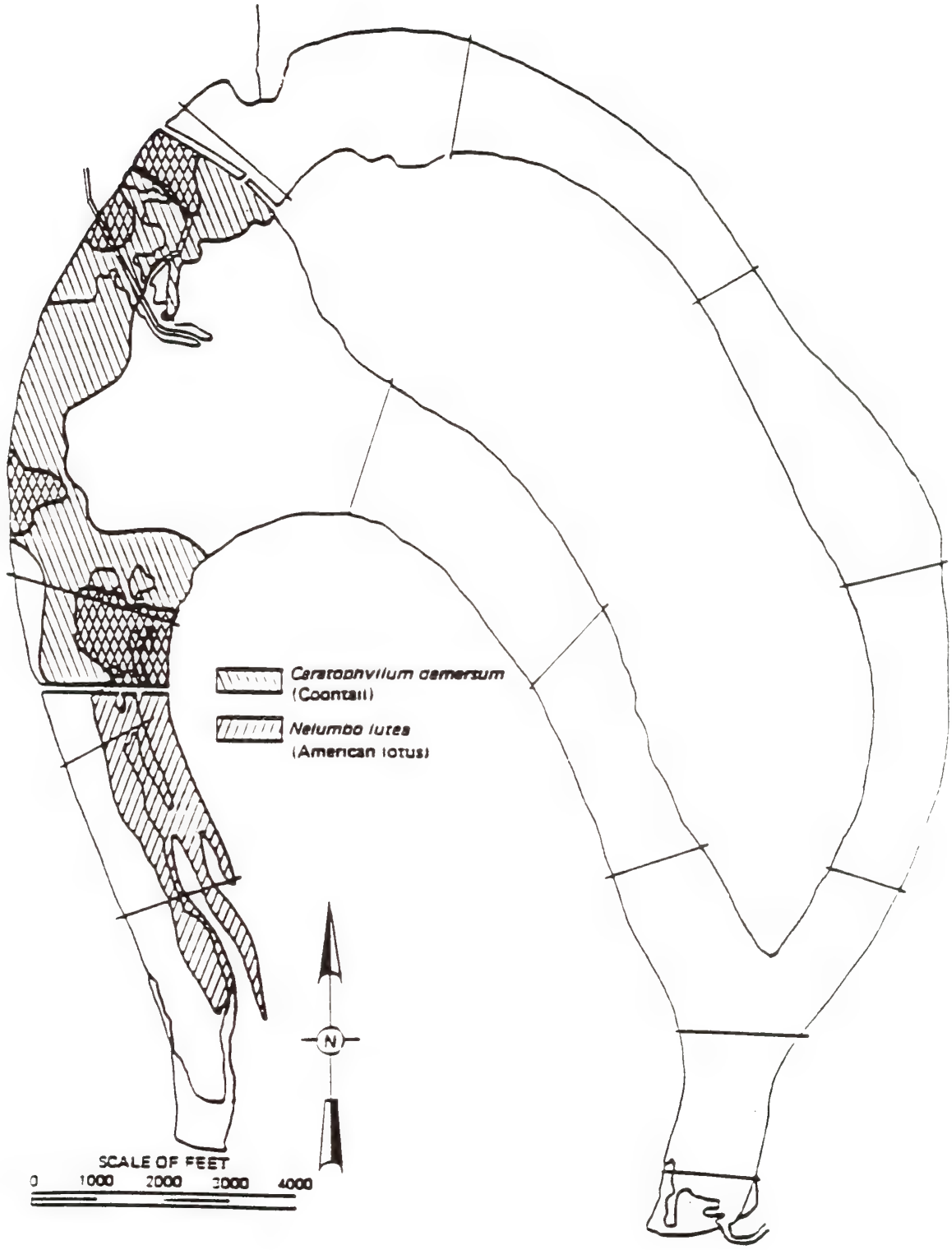


FIGURE 1-2. Location of primary macrophyte beds in Horseshoe Lake, Alexander County, Illinois, in 1984 (from Lee et al. 1986).

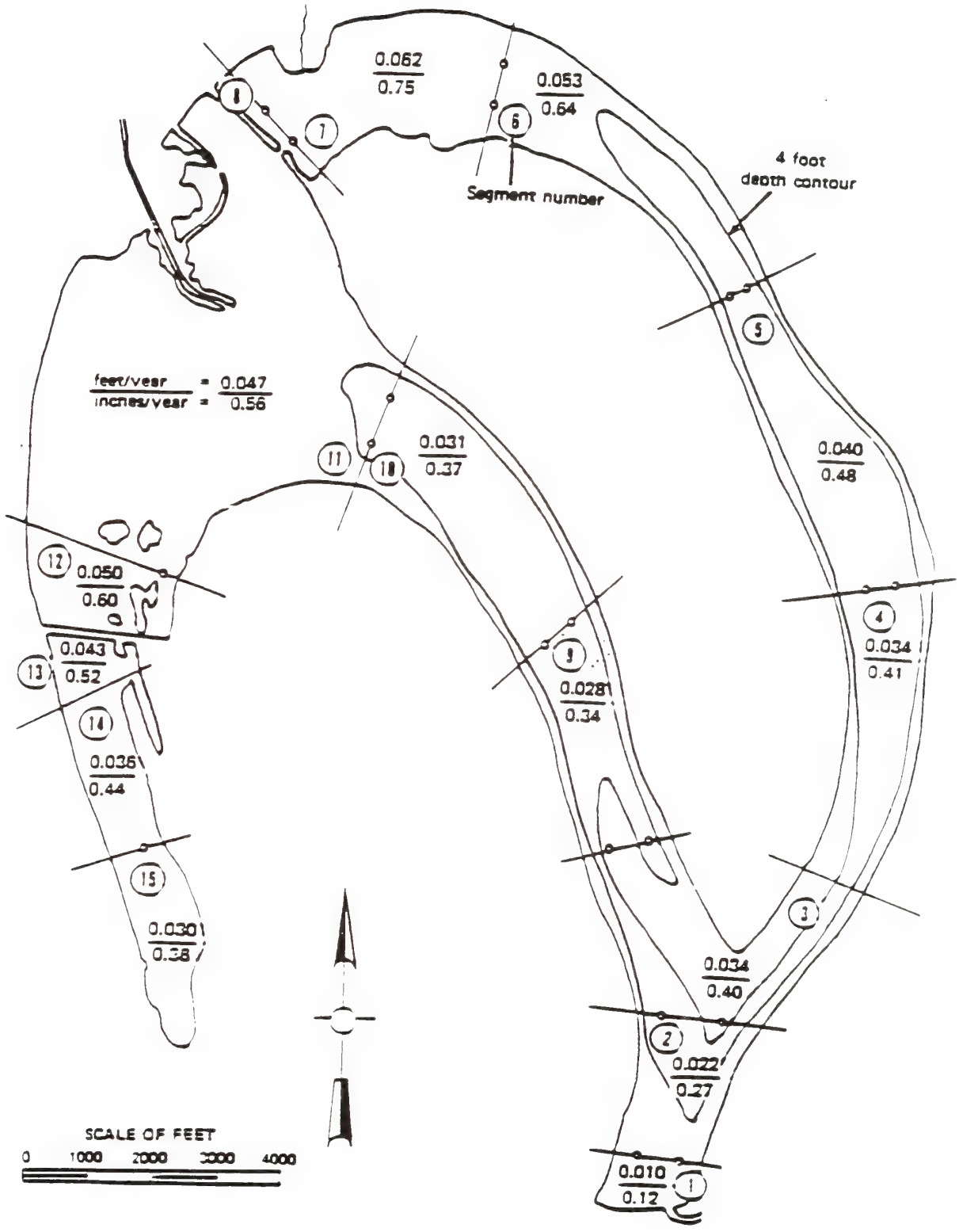


FIGURE 1-3. Siltation rates in Horseshoe Lake, Alexander County, Illinois, from 1951 to 1984 (from Lee et al. 1986).

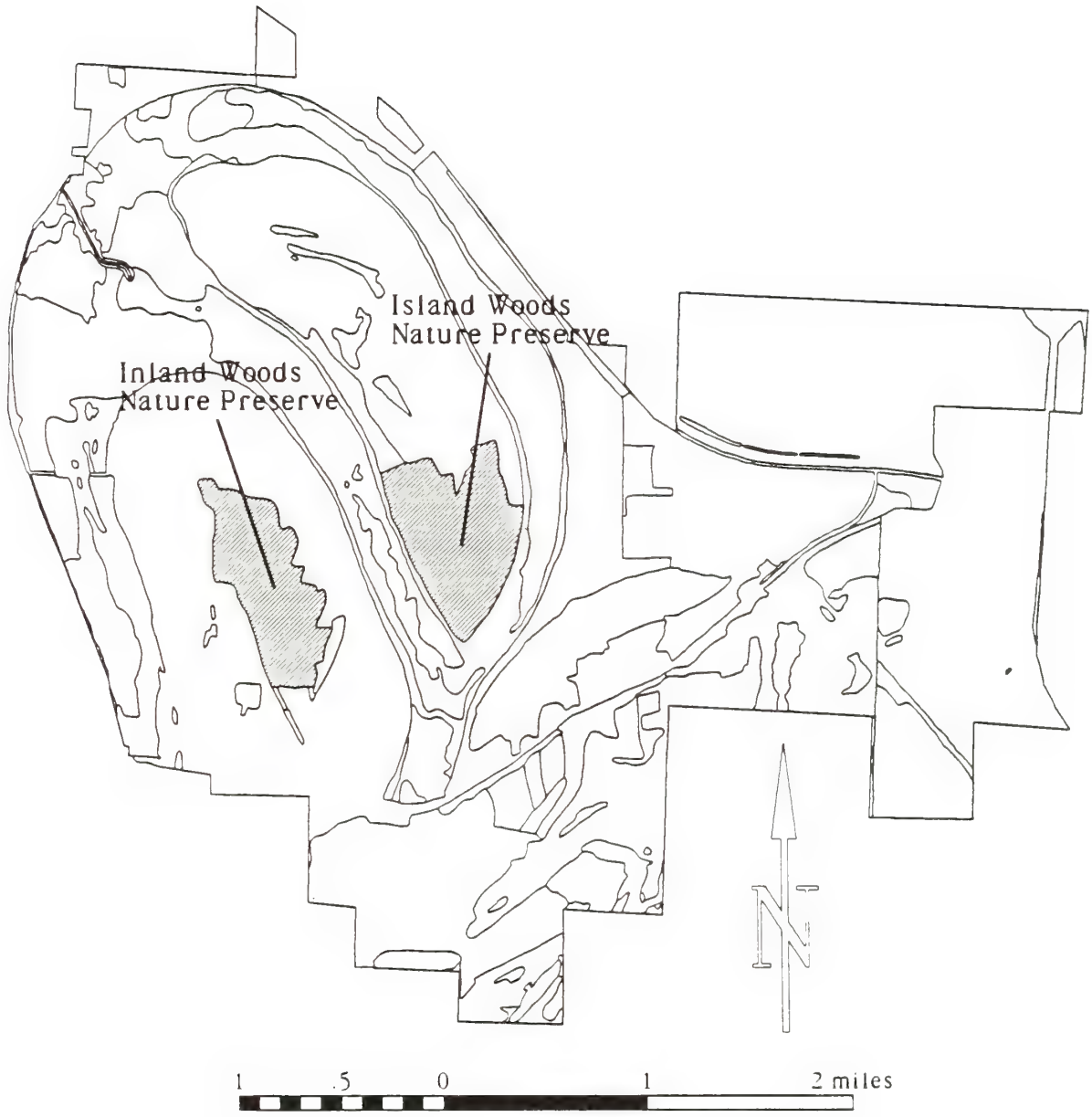


FIGURE 1-4. Location of Inland Woods and Island Woods Nature Preserves at Horseshoe Lake, Alexander County, Illinois.

JOB 2. VEGETATION MAPPING

Robert J. Gates

PART ONE

Introduction

Job 2 was intended to provide general information on the current area and distribution of the general vegetation and land use types within Horseshoe Lake Conservation Area (CA). Information reported in this section provides background data for the study area in addition to that presented in the study area description in the preceding section (Job1. Literature Review). A color-coded map was produced that identifies the locations and geographic coverage of the area by 12 different vegetation community or land use types. The general vegetation community classification formed the basis for surveys of the plant community and general forest composition of the area. Other products included a statistical summary of vegetation community and land use patterns on the area, and base maps on which sampling points and species record locations were recorded.

Objectives

The objectives of this portion of the study were to: 1) map the general vegetation communities of Horseshoe Lake CA and immediate vicinity from aerial photography, with verification by on-site visits, 2) provide summary data on the distribution and total area of individual plant communities, 3) produce a base map for plotting sampling points/transects, distributions, and site records of threatened, endangered, and special interest plant and animal species, and 4) digitize topographic maps of the study site for spatial analysis of flooding extent associated with raising the lake level from 322.0 to 324.0 feet MSL, and overlay projected flooding extent on distribution and range maps of plant and animal communities.

Methods

General vegetation communities and land use types within Horseshoe Lake CA were mapped by interpreting National Aerial Photography Program (NAPP) photographs (acquisition dates 22 and 27 March 1988). These photographs provided coverage of the study area before tree leaf-on and vigorous growth of herbaceous vegetation and crops. Color infrared NAPP transparencies were digitized by optical scanning (200 dots/in) to a computer image format using image processing and geographic information system (GIS)

software (The Map and Image Processing System, MicroImages, Inc., Lincoln, NE). Vegetation and land use types visible in the resulting computer image were digitized by on-screen tracing of the boundaries of identifiable surface features with an input device (computer mouse). Aerial photograph interpretations were guided by visits to specific sites in the course of field work conducted under other jobs. National wetlands inventory (NWI) data in digital format (vector) were also overlayed on scanned aerial photographs and completed vegetation maps to help verify photographic interpretations. Vegetation community and land use types that were interpreted and mapped from aerial photography included: 1) bald cypress/water tupelo swamp, 2) swamp forest, 3) bottomland hardwood forest, 4) shrub/scrub, 5) emergent wetland, 6) open lake, 7) shallow pond, 8) stream/drainage, 9) idle/old field, 10) bare soil, 11) cropland, 12) developed (urban, recreation, and residential areas), and 13) miscellaneous features (roads, bridges, etc.).

General study area maps for plotting sampling sites and species locations were produced by intersecting the digitized boundary of Horseshoe Lake CA with NWI vector coverages of the study area. The current legal boundaries of Horseshoe Lake CA were digitized from recent (1988) plat maps and overlaid on the completed vegetation/land use map. The boundary of Horseshoe Lake CA was updated to include the recently acquired portion of the area located on the east side and referred to as "The Poor Farm". A digital (raster format) map of the Horseshoe Lake study area was produced, and summaries of total areas of vegetation/land use types were output from the geographical information system.

Results

Vegetation Mapping

The vegetation/land use map appears as Appendix 2-A in this section of the report. The following is a brief description of the vegetation and land use features that were mapped in Appendix 2-A.

Cypress/tupelo swamp--Included portions of Horseshoe Lake and adjacent areas where trees were visible over surface water. This feature does not represent the general distribution of cypress and tupelo, as these species also occurred in more permanently flooded portions of bottomland forest that occurred on the area (see Job 4. Plant Community Surveys).

Swamp forest.--Included areas with woody vegetation exceeding 20 ft in height. This feature was distinct from cypress/tupelo swamp in that it occurred outside the basin of Horseshoe Lake (>324 ft MSL). Swamp forest was identified from aerial photographs as those areas where surface water was visible through the tree canopy on aerial photographs. Consequently, swamp forest was limited to local topographic depressions within deciduous bottomland forest where water was present in late March 1988. These areas were typically classified by NWI as areas with seasonal to semipermanent water regimes.

Bottomland Hardwood Forest.--Included areas with woody vegetation exceeding 20 ft in height, where there was no evidence of surface water visible through the tree canopy. Thus, this feature occurred on drier sites at topographic elevations above those of swamp forest. These areas were typically classified by NWI as non-wetland, or areas with saturated to temporary water regimes.

Shrub/scrub.--Included areas where woody vegetation did not exceed 20 ft in height, and at topographical elevations where there was no visible surface water. These areas were classified by NWI as having temporary water regimes. They typically occurred within forest tracts where woody vegetation was becoming reestablished after logging.

Open lake.--Consisted of areas within the basin of Horseshoe Lake where there was no evidence of a continuous tree canopy was visible from aerial photographs. Herbaceous emergent vegetation was present in shallower portions of this feature after spring emergence.

Shallow pond.--Included topographic depressions outside of the lake basin that contained surface water most of the year, and that were dominated by aquatic, rather emergent vegetation. These features typically had seasonal to semipermanent water regimes.

Emergent wetland.--Included areas devoid of woody vegetation where surface water or saturated soils were visible from aerial photographs. This feature type typically contained emergent herbaceous wetland vegetation, or consisted of topographic depressions located within cropland where surface water collected during spring. NWI typically classified water regimes within this feature type as saturated to semipermanent.

Stream/drainage.--Included narrow linear features where surface water was visible in aerial photographs and that drained water from portions of the area. This feature included natural streams and man-made ditches.

Idle/old field.--Included non-wetland areas currently not under cultivation and dominated by perennial herbaceous vegetation. This feature included former cropland in early stages of succession, road rights-of-way, and other areas that were maintained by mowing or haying. The only substantial tracts of this feature occurred on the island portion of the area.

Bare soil.--Was limited to the stream delta of Black Creek, located in the northwest portion of Horseshoe Lake. This was an apparent area of newly deposited sediment on which vegetation had not yet become established.

Cropland.--Included areas devoted annually to production of row crops such as corn, winter wheat, and soybeans. This feature would also include any areas left fallow in an annual rotation of row cropping.

Developed.--Features included any areas and their immediate vicinity that were visibly impacted by human construction. These included urban and residential areas, farm and equipment buildings, campgrounds and picnic sites, and other areas maintained for human use other than agriculture.

Miscellaneous.--Features included any not previously described and were limited to the causeways leading to the north part of the island and the west segment of the thumb. Also included in this feature was the segment of Illinois Route 127 and associated right-of-way that bisected the northwest corner of Horseshoe Lake CA. Other highways and secondary roads were not digitized.

Vegetation/Land Use Summary

Cropland comprised approximately one-third of the land area of Horseshoe Lake CA in 1993 (Table 2-1). However, there were substantial tracts of forested wetlands and swamps (including cypress/tupelo) that covered about 45% (4,122 ac) of the total area. Additionally, there were about 180 ac of shallow emergent wetlands and ponds. These features were generally located in local topographic depressions that were devoid of woody vegetation. Many of the shallow emergent wetlands were located in cultivated basins, although some areas were not annually tilled and these supported natural hydrophyte communities (see Job 4. Plant Community Surveys).

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON THE AREA AND DISTRIBUTION OF VEGETATION COMMUNITIES

After inspecting 7.5′ quadrangle maps of the study area, it was determined that digitization of elevation contours would not be necessary, or adequate to identify areas that would be inundated with increases in lake level between 322 and 324 ft MSL. The 325 ft elevation contour was generally very close to the lake shore, except in the southwest arm of the lake. It was evident from viewing the lake shoreline that raising the lake level up to 324 ft MSL would not cause substantial inundation of any areas outside of the lake basin.

Increasing the lake level by 6 in increments between 322 and 324 ft MSL would not cause substantial changes in total area inundated. With relatively steeply sloping banks, a 2 ft rise in lake level would likely have direct impacts within a <20 ft zone surrounding the lake shoreline at the current managed lake level. Direct impacts of a higher managed lake pool on plant communities would be limited almost entirely to cypress/tupelo and bottomland forest communities that immediately surround the lake. However, if a rise in subsurface water levels accompany increased lake levels, then areas of swamp forest and emergent wetlands located in topographic depressions may expand. Impacts of increased lake level on ground and soil water relationships should be considered.

Acknowledgements

Technical assistance and advice in image processing and GIS analyses provided by Thomas Hollenhorst and Robert Kawula are gratefully acknowledged. Jody Shimp and Barbara Janiak interpreted aerial photography and digitized vegetation/land use maps.

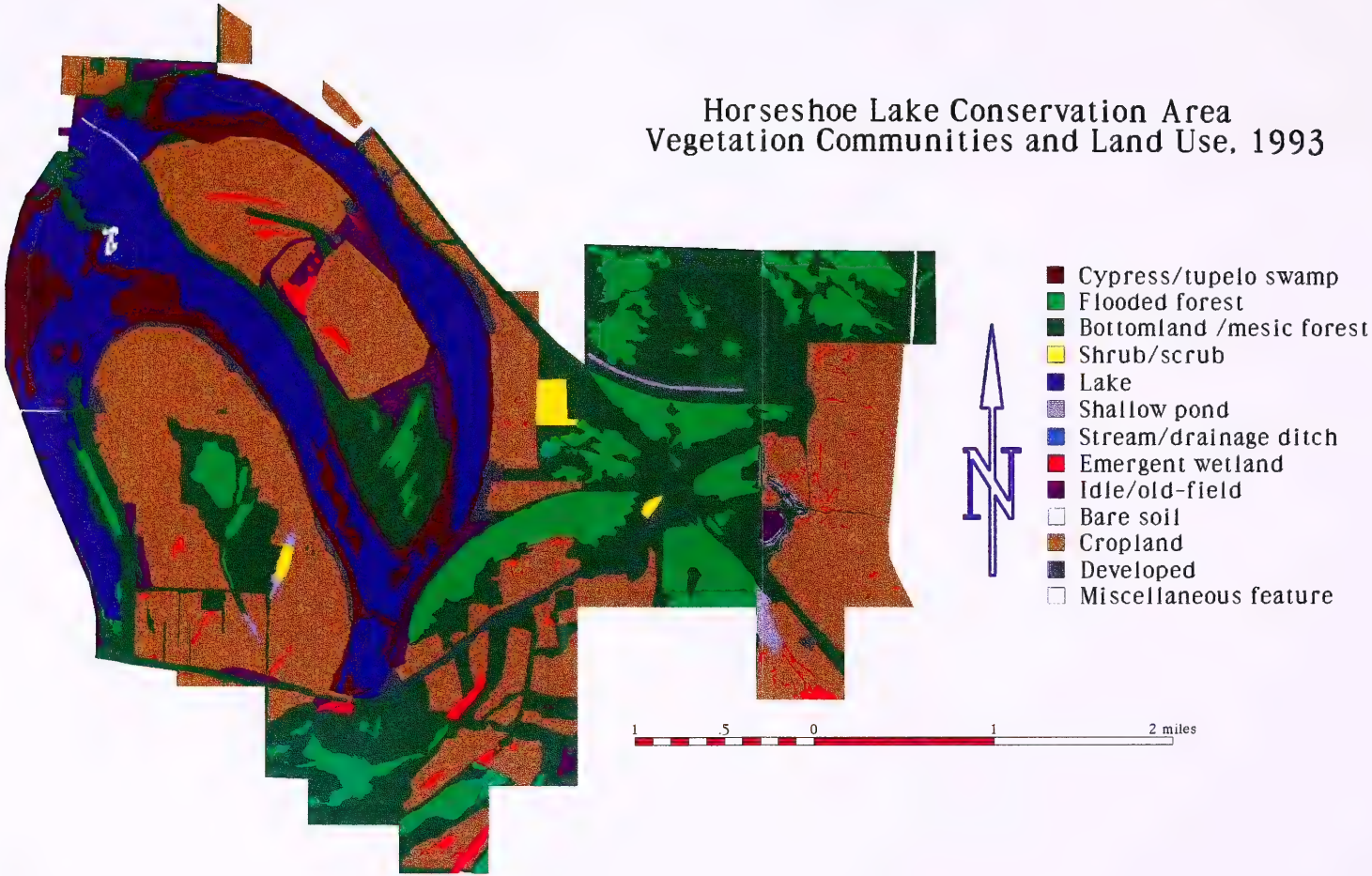
TABLE 2-1. Summary statistics of general vegetation communities and land use features within Horseshoe Lake Conservation Area, summer 1993.

Feature Type	Total Perimeter (mi)	Total Area ac	Total Area %
Cypress/tupelo	129.1	583.4	6.4
Swamp forest	144.5	970.5	10.6
Bottomland forest	403.2	2,566.8	28.1
Shrub/scrub	5.8	42.0	0.5
Open lake	110.6	1,380.5	15.1
Shallow pond	25.1	51.4	0.6
Emergent wetland	72.6	129.4	1.4
Stream/drainage	110.6	20.7	0.2
Idle/old-field	61.1	235.1	2.6
Bare soil	2.9	4.9	0.1
Cropland	246.4	3,029.5	33.2
Developed	40.0	112.9	1.2
Miscellaneous	7.4	10.1	0.1
Total	--	9,137.3	100.1

Appendix 2-A. General vegetation and land use map of Horseshoe Lake Conservation Area.

Appendix 2-A. General vegetation and land use map of Horseshoe Lake Conservation Area.

Horseshoe Lake Conservation Area
Vegetation Communities and Land Use, 1993



JOB 3. FOREST COMMUNITY DESCRIPTION

Robert J. Gates and Donna M. Hertlein

PART ONE

SURVEY

Introduction

Forest communities were previously studied at Horseshoe Lake Conservation Area (CA) by Robertson (1978) and Robertson et al. (1978, 1984). These studies were conducted on the island portion of Horseshoe Lake CA, specifically within the Island Woods Nature Preserve. Robertson et al. (1978) found that basal area, density, and floristic composition of the old-growth stand were typical of much of the original Southern Floodplain Forest. They also concluded that species were separated along a coenocline in response to a moisture/flooding gradient. Robertson et al. (1984) found that depth of flooding and soil clay content were the physical variables most strongly associated with the overstory coenocline. Understory density and overstory basal area increased, and species richness and heterogeneity decreased from upland to swamp ends of the physical gradient.

Baker (1983) studied the herbaceous stratum and its relationship to overstory and soil-site variables within the old-growth forest stand at Horseshoe Lake CA. He found that Distinct herbaceous communities existed along a moisture gradient in the spring but these communities merged to form a single, less distinct community by autumn. Baker (1983) also reported specific associations between herbaceous and overstory species along the moisture gradient. Associations between Ozmorhiza longistylis and Fagus grandifolia, Saururus cernuus and Acer rubrum, Bidens aristosa and Plantanus occidentalis, and Impatiens biflora and Carya glabra were significant and were thought to be characteristic of southern Illinois bottomland forests

Objective

The objective of this portion of the study was to survey the current species composition and stand structure (density and basal area of mature trees, saplings, and seedlings) of forest communities within Horseshoe Lake CA.

Methods

Sample sites were randomly located within individual forest tracts identified and mapped from aerial photography and National Wetlands Inventory (NWI) data (see Job 2. Vegetation Mapping). These plots were not permanently marked in the field. Sampling effort was distributed among 9 individual forest tracts in proportion to their total areas. We intended to sample all forested areas $\geq$ 10 ac total area, but 2 tracts were not sampled due to extreme flooding during summer and fall 1993. A total of 90 plots were randomly located in 7 forest tracts (Figure 3-1). Plots were sampled during 14 October - 18 November 1994 when flood waters had receded sufficiently to permit access to forested areas. The largest tract encompassed 801 ac (324 ha) and was sampled with 34 plots. The smallest tract was 13 ac (5.3 ha) and contained only 3 plots. Portions within forest tracts identified as swamp sites were generally not sampled except within the Inland Woods (Tract 2) and Island Woods Nature Preserves (Tract 6).

Species composition, densities, and basal areas of mature trees (dbh $\geq$ 17 in) were recorded within 478 yd^2 (400 m^2) rectangular quadrats. Basal areas of mature trees were determined by measuring diameters at breast height (dbh). Species composition and densities of saplings (dbh $\geq$ 1.0 in and < 17 in) were measured concurrently on 478 yd^2 (400 m^2) rectangular plots. Densities and basal areas were recorded using the metric system, so results summarized in Tables 3-2 and 3-3 are reported in metric units. Summer and fall flooding apparently killed or defoliated nearly all seedlings present, therefore seedling densities and occurrence were not recorded. Data were summarized by individual forest tracts, defined as contiguous blocks of forest $\geq$ 10 ac area where woody vegetation exceeded 20 ft in height. Tree species were identified using Mohlenbrock (1986).

Results

Scientific names of 45 tree species recorded on 90 plots located in 7 separate forest tracts during fall 1993 are listed in Table 3-1. These species were characteristic of bottomland forests of the Upper Mississippi Alluvial Valley (Braun 1950, Reid et al. 1988). Mean densities and basal areas of mature overstory and sapling trees are reported in Tables 3-2 and 3-3, respectively. Additional descriptions of forest communities are found in Job 4, Plant Community Surveys.

Forest tract 1 (13 ac), was at a slightly higher topographical elevation than other areas sampled, but

contained local depressions. Consequently, minimal flood damage to understory vegetation was apparent in this tract. Sweetgum and slippery elm were the principal overstory forest trees, with bitternut hickory and cherrybark oak interspersed as secondary dominants (Table 3-2). Overstory species composition was not reflected by the sapling layer. Pawpaw, a shade tolerant species, was the primary sapling species with stem densities 14 time greater than any other sapling (Table 3-3).

Forest tract 2, (299 ac) was located on the south end of the island (Island Woods Nature Preserve). This tract contained old-growth and secondary growth forest stands (Robertson et al. 1978). Extraordinarily large diameter beech, bald cypress, and tupelo gum occurred in the overstory of the old-growth stand in the Island Woods Nature Preserve. However, stem densities of these species were low (Table 3-2), a characteristic of old-growth forests. In contrast, the secondary growth forest stand contained a diverse array of species, primarily bitternut hickory, sweetgum, overcup oak, and swamp chestnut oak (Table 3-2). Topographical variation within this tract produced noticeable transitions in forest composition along moisture gradients on the island. Bald cypress and tupelo gum with a sapling layer of red maple and pumpkin ash predominated in old-growth swamp sites. Beech, sugar maple, red buckeye and pawpaw occurred on drier sites in old-growth stands. An overstory of overcup oak and sweetgum with a red maple sapling layer occurred on wetter sites of the secondary forest, while shagbark hickory and swamp chestnut oak occurred on drier sites. Areas of recently damaged and downed timber were common, suggesting this area of Horseshoe Lake CA sustained heavy wind damage during summer and fall 1993. Evidence of flooding was widespread as indicated by readily distinguishable waterlines on trees, scattered flood debris, and large amounts of dead or brown understory vegetation.

Forest tract 3, located north of Illinois State Highway 3 was the largest tract (800 ac) surveyed. This tract had the greatest species richness (26 species) of all 7 tracts sampled (Tables 3-2, 3-3). A tributary of Lake Creek bisected this tract diagonally, dividing the area into 2 portions. The western portion was wet, with undulating topography and numerous local depressions. A pin oak overstory predominated, with a brushy understory of red maple saplings with high mean stem densities (Tables 3-2, 3-3). Dead logs, snags, and basal swelling were evident, indicating that trees had experienced water stress, probably due to beaver activity that maintained high water levels.

The ground was saturated or slightly puddled in the eastern portion of tract 3. Forest composition was more diverse than in the western portion and included sweetgum, shagbark and bitternut hickories, slippery elm, swamp chestnut, cherrybark and bur oaks (Table 3-2). Red maple in association with sweetgum and slippery elm comprised the sapling layer (Table 3-3). This species association is typical of lowland hardwood forests. The timber in this portion was well stocked and appeared vigorous.

Forest tracts 4 and 5 were essentially contiguous areas, with tract 5 located southwest of tract 4 (Figure 3-1). Forest composition, stand vigor, and topography on higher sites resembled the eastern portion of tract 3. Mixed hardwoods with a red maple understory occurred on this tract. Species composition was similar between the overstory and sapling layers, suggesting the forest community was regenerating itself in most of the areas sampled (Tables 3-2, 3-3). Areas of young successional stands (brushy sweetgum, elm, and maple) were found in tract 4. A swamp region in the north portion of tract 5 was not sampled intensively, however, large tupelo gum, green ash and black willow occurred in this area.

Forest tract 6 was a 217 ac area that comprised the Inland Woods Nature Preserve located on the thumb of Horseshoe Lake CA. The dominant topographic and vegetation feature was the swamp located in the interior portion of tract 6. Density, basal area and species composition of the swamp in tract 6 resembled that of tract 2. Large tupelo gum, bald cypress, and green ash were found in areas where water was approximately 5 ft deep during fall 1993. A pin oak - sweetgum overstory with a red maple sapling layer occurred along the outer margins of the interior swamp. Pawpaw was interspersed in the sapling layer on drier sites, similar to the old-growth stand in the Island Woods Nature Preserve (Tables 3-2 and 3-3). Fallen and damaged timber was conspicuous suggesting that this area also sustained wind damage during summer and/or fall 1993.

Forest tract 7, 114 ac (46 ha), was located immediately adjacent to the southwest arm of Horseshoe Lake. The riparian location of this tract was indicated by the presence of sycamore as a common species (Table 3-2). A large portion of this tract was dominated by a dog-hair stand of bald cypress, tupelo gum and black willow (Tables 3-2, 3-3). The forest type on the western edge of this tract was a mixture of green ash, red maple, and bald cypress. Trees were in medium to small size classes suggesting a mid-successional forest. The eastern portion of the tract had higher elevation, and the overstory forest type was primarily sweetgum and overcup oak. Ashes and

maples were the dominant sapling species. Previous inundation by floodwaters was evident here. Scattered debris, dead or brown understory vegetation, and high waterlines were apparent.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON FOREST STANDS

Flooding during summer and early fall 1993 completely inundated all but one of the forest tracts (Tract 1) that we sampled. Waterlines up to 2.5 ft high were evident on trees in some areas, and the current year's growth of understory vegetation appeared to be destroyed in nearly all areas sampled. Floodplain forest communities are highly influenced by regional and local hydrologic conditions. Modifications of the hydrological regime that cause flooding during the growing season or increased water depths will affect growth, survival and composition of forest stands. Certain species such as red maple, green and pumpkin ash, bald cypress and tupelo gum are adapted to flooding and anoxic conditions. However, other species such as pin, cherrybark, swamp chestnut, and swamp white oaks, sweetgum, and persimmon are intolerant or moderately tolerant of flooding (McKnight et al. 1981).

Poor soil aeration that accompanies flooding causes physiological changes in woody plants that influence growth and species composition of forest stands (McKnight et al. 1981, Kozlowski 1984). Prolonged flooding primarily affects plant roots. Damage occurs when there is insufficient oxygen in the water for root respiration (Kozlowski 1984). Survival is inhibited by anaerobic soil conditions and the extent of damage increases with flooding duration (Huffman and Forsythe 1981). Stagnant, deep water during the growing season causes the greatest damage to lowland hardwood communities (Loucks 1987). Most species have high oxygen demand during the growing season and oxygen is rapidly depleted in warm, lotic water, thus depriving roots of needed oxygen (Broadfoot and Williston 1973).

Dellinger et al. (1976) investigated effects of continuous spring and summer flooding on bottomland hardwoods in southern Illinois and found that substantial mortality occurred in nearly all species subjected to continuous flooding for 83 days after leaves emerged. Broadfoot and Williston (1973) found that most seedlings were killed if their crowns were covered by water more than 2 weeks after leaf emergence.

Increasing the lake level should not directly impact most of the forest tracts that we sampled in this survey. Tract 7 was the only non-cypress/tupelo forest community that occurred adjacent to the lake. Although most of this tract was located above 324 ft MSL, increased lake levels may affect subsurface water levels that could produce anoxic soil conditions during the growing season. This may produce a gradual shift in forest composition to more water tolerant tree species on newly inundated areas. Water tolerant species such as red maple, bald cypress, tupelo gum, and buttonbush that are already present may experience increased water stress, but will likely survive stabilization of the lake level at higher elevations (McKnight et al. 1981).

The 1993 flood may have more widespread and long-term impacts on the structure and species composition of forest communities at Horseshoe Lake CA. All but one of the forest tracts that we sampled were inundated for most of the 1993 growing season. Water levels were abnormally high during spring when trees broke dormancy. There was a period of less than 2 months between early June and mid-July 1993 when forest communities were not inundated by spring or summer flooding. Although bottomland forest species are somewhat tolerant of flooding during the growing season, repeated and prolonged flooding induces physiological stress that can lead to damage and/or mortality (Kozlowski 1984). Flooding that re-occurred in spring 1994 likely added to the physiological stress experienced by trees during the 1993 growing season. Some mortality of flood intolerant species might be expected to result from recent flood events (Loucks 1987). Of greatest concern are the old-growth beech trees on the Island Woods Nature Preserve.

Widespread mortality of understory vegetation was apparent during the forest community survey in fall 1993. Any flood-induced losses or change in the regenerating sapling stratum could influence future forest structure and composition (Frederickson 1979). Follow-up studies are needed to determine whether substantial tree mortality occurred at Horseshoe Lake CA after flooding by the Mississippi River in 1993 and 1994.

Acknowledgements

Assistance with forest sampling was provided by Pete Bergmann, Dave Sample and John Lane. Computer data entry and proofing was performed by John Watts. Their help is gratefully acknowledged.

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TABLE 3-1. List of tree species found within 90 400 m^2 quadrats located in 7 bottomland hardwood forest tracts at Horseshoe Lake CA in southern Illinois during fall 1993.

Common name	Scientific name
Red maple[a]	Acer rubrum
Sugar maple	Acer saccharum
Red buckeye	Aesculus discolor
Pawpaw	Asimina triloba
Blue beech/Musclewood	Carpinus caroliniana
Pignut hickory	Carya glabra
Bitternut hickory	Carya cordiformis
Pecan	Carya illinoensis
Shagbark hickory	Carya ovata
Hackberry[b]	Celtis occidentalis
Buttonbush	Cephalanthus occidentalis
Rough-leaved dogwood	Cornus drummondii
Flowering dogwood	Cornus florida
Stiff dogwood	Cornus foemina
Hawthorn	Crataegus spp.
Cock-spur hawthorn	Crataegus crus-galli
Persimmon	Diospyros virginiana
Beech	Fagus grandifolia
White ash	Fraxinus americana

TABLE 3-1. Continued.

Common name	Scientific name
Green ash	Fraxinus pennsylvanica var. subintegerrima
Pumpkin ash	Fraxinus tomentosa
Honey Locust	Gleditsia triancanthos
Deciduous holly	Ilex decidua
Sweetgum	Liquidamber styraciflua
Tupelo gum	Nyssa aquatica
Black gum	Nyssa sylvatica
Sycamore	Plantanus occidentalis
Cottonwood	Populus deltoides
Swamp cottonwood	Populus heterophylla
Black cherry	Prunus serotina
White oak	Quercus alba
Swamp white oak	Quercus bicolor
Overcup oak	Quercus lyrata
Bur oak	Quercus macrocarpa
Swamp chestnut oak	Quercus michauxii
Cherrybark oak	Quercus pagodaefolia
Pin oak	Quercus palustris
Northern red oak	Quercus rubra
Shumard's oak	Quercus shumardii

TABLE 3-1. Continued.

Common name	Scientific name
Smooth sumac	Rhus glabra
Black willow	Salix nigra
Sassafras	Sassafras albidium
Bald cypress	Taxodium distichium
Winged elm	Ulmus alata
Slippery elm	Ulmus rubra

[a] Red maple included Acer rubrum and Acer rubrum var. drummondii

[b] Hackberry included Celtis occidentalis and Celtis laevigata

TABLE 3-2. Density and basal area of overstory tree species in forest tracts at Horseshoe Lake Conservation Area in southern Illinois during 1993.

Forest Tract	Species[a]	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
1	Asimina triloba	0.2	0.2	33.3	33.3
	Carya cordiformis	1.5	1.5	8.3	8.3
	Carya ovata	0.9	0.6	33.3	16.7
	Celtis occidentalis	1.1	0.6	41.3	22.0
	Gleditsia triancanthos	1.0	0.6	8.3	8.3
	Liquidambar styraciflua	18.0	9.5	183.3	83.3
	Quercus pagodaefolia	1.6	1.6	8.3	8.3
	Ulmus rubra	5.0	3.0	116.7	30.0
2	Acer rubrum	1.5	0.7	26.6	11.3
	Acer saccharum	1.4	0.5	71.9	23.5
	Asimina triloba	0.7	0.5	48.4	20.7
	Carya cordiformis	3.8	1.5	15.6	6.4

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
2	*Carya ovata*	0.8	0.7	12.5	8.2
	Diospyros virginiana	0.6	0.5	18.8	17.1
	Fagus grandifolia	1.7	1.2	3.1	2.1
	Fraxinus americana	1.6	0.8	18.6	7.7
	Fraxinus pennsylvanica var. *subintegerrima*	1.7	0.8	17.2	7.5
	Liquidambar styraciflua	9.8	2.9	53.1	17.6
	Nyssa aquatica	0.1	0.1	1.6	1.6
	Nyssa sylvatica	0.4	0.4	1.6	1.6
	Populus deltoides	0.7	0.7	3.1	3.1
	Populus heterophylla	0.6	0.6	4.7	4.7
	Quercus alba	0.3	0.3	1.6	1.6
	Quercus bicolor	0.2	0.2	1.6	1.6

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
2	*Quercus lyrata*	1.8	1.2	4.7	2.5
	Quercus michauxii	2.2	1.9	15.6	6.8
	Quercus pagodaefolia	0.4	0.4	1.6	1.6
	Quercus palustris	0.7	0.5	3.1	2.1
	Quercus rubra	0.1	0.1	3.1	3.1
	Quercus shumardii	1.9	1.3	3.1	3.1
	Sassafras albidium	0.6	0.4	3.1	3.1
	Taxodium distichium	2.2	2.2	3.1	3.1
	Ulmus rubra	0.2	0.1	9.4	3.1
3	*Acer rubrum*	2.8	0.7	147.1	26.5
	Carya cordiformis	0.1	0.1	4.4	4.4
	Carya ovata	2.3	0.5	96.3	18.5

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
3	Celtis occidentalis	0.1	0.1	4.4	2.5
	Crataegus crus-galli	0.1	0.1	2.2	1.6
	Fraxinus americana	0.1	0.1	2.9	1.7
	Fraxinus pennsylvanica var. subintegerrima	0.1	0.0	3.7	1.8
	Gleditsia triancanthos	0.3	0.3	1.5	1.5
	Liquidambar styraciflua	1.6	0.6	54.5	19.9
	Nyssa sylvatica	0.5	0.3	4.4	2.2
	Plantanus occidentalis	0.1	0.1	4.4	2.2
	Populus deltoides	0.3	0.3	3.7	3.7
	Quercus alba	0.1	0.1	1.5	1.0
	Quercus bicolor	2.4	0.6	17.6	4.5
	Quercus lyrata	2.0	0.7	18.0	5.5

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
3	Quercus macrocarpa	0.3	0.2	2.9	2.3
	Quercus michauxii	0.7	0.4	6.6	4.0
	Quercus pagodaefolia	2.2	0.7	17.0	5.2
	Quercus palustris	8.9	1.7	51.4	9.0
	Quercus rubra	0.1	0.1	1.5	1.5
	Ulmus alata	0.1	0.0	6.6	2.9
	Ulmus rubra	1.5	0.4	54.4	10.7
4	Acer rubrum	1.3	0.5	92.9	22.6
	Carya ovata	1.7	0.5	117.9	27.2
	Fraxinus pennsylvanica var. subintegerrima	0.2	0.2	7.1	4.1
	Liquidambar styraciflua	4.6	1.1	100.0	20.1
	Quercus bicolor	6.1	2.9	37.5	16.1

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
4	Quercus lyrata	2.9	1.6	23.2	11.7
	Quercus macrocarpa	0.5	0.5	3.6	3.6
	Quercus pagodaefolia	6.2	2.6	41.1	14.9
	Quercus palustris	10.3	2.6	71.6	14.1
	Sassafras albidium	0.4	0.4	1.7	1.7
	Ulmus rubra	4.4	1.2	107.1	24.9
5	Acer rubrum	0.4	0.4	12.5	12.5
	Carya cordiformis	1.2	0.6	43.7	21.3
	Carya ovata	4.3	3.0	75.0	43.0
	Celtis occidentalis	3.7	3.1	56.2	40.1
	Diospyros virginiana	0.6	0.6	6.3	6.3
	Fraxinus pennsylvanica var. subintegerrima	0.2	0.2	12.5	12.5

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
5	*Gleditsia triancanthos*	1.1	1.1	6.3	6.3
	Liquidambar styraciflua	6.6	3.8	93.7	27.7
	Quercus alba	1.7	1.7	6.3	6.3
	Quercus bicolor	0.3	0.3	6.3	6.3
	Quercus michauxii	0.1	0.1	6.3	6.3
	Quercus pagodaefolia	3.0	1.7	12.5	7.2
	Quercus palustris	6.2	3.8	25.0	17.7
	Ulmus rubra	5.5	3.7	68.7	27.7
6	*Acer rubrum*	8.1	2.8	153.8	29.1
	Acer saccharum	0.4	0.4	13.4	13.4
	Carya illinoensis	0.8	0.8	3.8	3.8
	Celtis occidentalis	0.8	0.4	40.3	21.9

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
6	Diospyros virginiana	0.2	0.2	13.5	13.5
	Fraxinus pennsylvanica var. subintegerrima	0.8	0.4	11.5	4.6
	Gleditsia triancanthos	0.7	0.7	1.9	1.9
	Liquidambar styraciflua	10.8	3.7	59.6	15.4
	Nyssa aquatica	6.2	3.1	48.1	22.1
	Plantanus occidentalis	0.3	0.2	5.8	3.0
	Prunus serotina	0.1	0.1	1.9	1.9
	Quercus lyrata	0.6	0.4	3.8	2.6
	Quercus pagodaefolia	0.4	0.4	1.9	1.9
	Quercus palustris	8.6	3.8	30.8	15.0
	Taxodium distichium	4.9	2.5	11.5	5.4
	Ulmus rubra	1.3	0.6	28.8	8.9

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
7	*Acer rubrum*	6.7	3.8	183.3	92.7
	Carya cordiformis	1.2	1.2	45.8	45.8
	Diospyros virginiana	0.3	0.3	12.5	8.5
	Fraxinus pennsylvanica var. *subintegerrima*	1.7	1.7	29.2	29.2
	Liquidambar styraciflua	8.5	3.9	179.2	83.6
	Nyssa aquatica	2.2	2.2	245.8	245.8
	Plantanus occidentalis	4.6	1.6	116.7	35.1
	Populus deltoides	3.6	2.7	25.0	12.9
	Quercus lyrata	1.9	1.3	54.2	35.6
	Quercus pagodaefolia	0.4	0.4	4.2	4.2
	Quercus palustris	0.4	0.4	4.2	4.2
	Salix nigra	1.8	1.8	41.6	41.6

TABLE 3-2. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
7	*Taxodium distichium*	0.6	0.4	50.0	37.1
	Ulmus rubra	0.2	0.1	25.0	15.8

[a] Species with Basal Area of < 0.1 m^2/ha were not listed.

TABLE 3-3. Density and basal area of tree species of the sapling layer in forest tracts at Horseshoe Lake Conservation Area in southern Illinois during 1993.

Forest Tract	Species[a]	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
1	Asimina triloba	0.45	0.31	366.6	41.6
	Celtis occidentalis	0.03	0.03	25.0	22.0
	Ulmus rubra	0.02	0.02	8.3	22.0
2	Acer saccharum	0.05	0.02	21.8	9.6
	Aesculus discolor	0.08	0.03	51.6	19.6
	Asimina triloba	0.31	0.10	185.9	60.1
	Carya ovata	0.01	0.01	4.8	3.4
	Rhus glabra	0.02	0.02	7.8	7.8
3	Acer rubrum	0.48	0.08	296.3	52.0
	Carya ovata	0.14	0.03	66.2	16.6
	Celtis occidentalis	0.01	0.01	13.2	6.3

TABLE 3-3. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
3	*Crataegus crus-galli*	0.01	0.01	25.7	11.4
	Fraxinus pennsylvanica var. *subintegerrima*	0.01	0.00	4.4	2.0
	Liquidambar styraciflua	0.14	0.09	27.9	8.6
	Quercus bicolor	0.11	0.11	0.7	0.7
	Quercus palustris	1.24	1.01	8.1	4.4
	Ulmus alata	0.04	0.01	25.7	11.4
	Ulmus rubra	0.12	0.02	71.3	15.7
4	*Acer rubrum*	0.22	0.07	157.1	47.1
	Carya ovata	0.22	0.06	133.9	38.3
	Fraxinus pennsylvanica var. *subintegerrima*	0.01	0.00	7.1	5.5
	Liquidambar styraciflua	0.03	0.01	16.1	6.7

TABLE 3-3. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
4	Quercus alba	0.02	0.02	10.7	10.7
	Ulmus alata	0.02	0.01	17.9	12.4
	Ulmus rubra	0.13	0.03	89.3	22.8
5	Acer rubrum	0.02	0.02	6.3	6.3
	Asimina triloba	0.06	0.03	50.0	28.9
	Carya cordiformis	0.02	0.02	6.3	6.3
	Celtis occidentalis	0.07	0.01	87.5	16.1
	Liquidamber styraciflua	0.02	0.02	6.3	6.3
	Quercus alba	0.01	0.01	6.3	6.3
	Sassafras albidium	0.02	0.02	25.0	25.0
	Ulmus alata	0.01	0.01	6.3	6.3
	Ulmus rubra	0.03	0.03	18.8	18.8
6	Acer saccharum	0.01	0.01	5.8	5.8

TABLE 3-3. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
6	Acer rubrum	0.01	0.01	119.2	38.6
	Asimina triloba	0.07	0.05	65.4	41.9
	Celtis occidentalis	0.03	0.02	26.9	12.5
	Diospyros virginiana	0.07	0.07	28.8	24.8
	Fraxinus americana	0.01	0.01	3.8	3.8
	Liquidambar styraciflua	0.02	0.01	9.6	5.3
	Populus heterophylla	0.02	0.02	7.7	7.7
	Ulmus rubra	0.05	0.03	26.9	14.6
7	Acer rubrum	0.21	0.16	91.7	67.3
	Cornus drummondii	0.04	0.04	20.8	20.8
	Diospyros virginiana	0.01	0.01	12.5	8.5
	Ilex decidua	0.06	0.04	41.7	27.1
	Liquidambar styraciflua	0.02	0.01	8.3	5.3

TABLE 3-3. Continued.

Forest Tract	Species	Basal Area (m^2/ha) $\bar{x}$	Basal Area (m^2/ha) SE	Density (No./ha) $\bar{x}$	Density (No./ha) SE
7	Nyssa aquatica	0.81	0.80	466.7	461.7
	Nyssa sylvatica	0.01	0.01	4.2	4.2
	Quercus palustris	0.02	0.02	8.3	8.3
	Taxodium distichum	0.04	0.03	16.7	10.5
	Ulmus rubra	0.03	0.02	16.7	8.3

[a] Species with Basal Area < 0.01 m^2/ha were not listed.

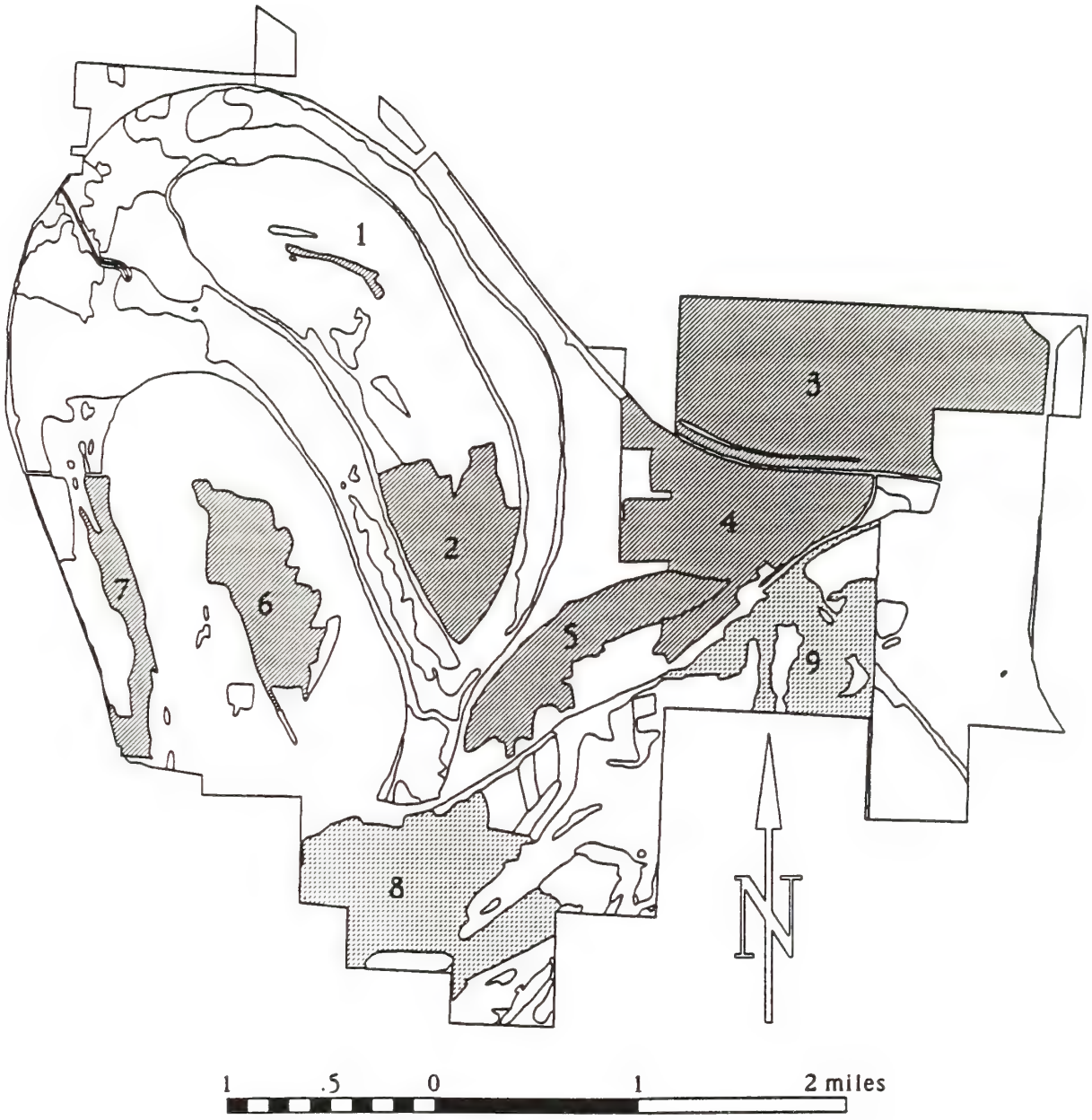

Figure 3-1. Contiguous tracts of bottomland forest at Horseshoe Lake CA. Solid cross-hatching indicates tract that were surveyed to determin forest structure and species composition during fall 1993. Stippled cross-hatching indicates tracts that were not sampled due to inundation by floodwaters during fall 1993.

JOB 4. PLANT COMMUNITIES

Robert J. Gates and Mark A. Basinger

PART ONE

SURVEY

Introduction

The flora of Horseshoe Lake Conservation Area was previously studied in 1968 by Huston (1972), who identified 521 vascular plant taxa from a limited portion of Horseshoe Lake CA. Basinger (1994) recently completed a floristic study of bald cypress swamps in the Cache River basin of southern Illinois. Three of Basinger's (1994) 25 study sites were located in cypress / tupelo swamp communities within the Horseshoe Lake basin. Permanently flooded cypress / tupelo swamps associated with the lake had the lowest species diversity among cypress swamps sampled by Basinger (1994).

The following describes the general floristic composition of representative vegetation communities within Horseshoe Lake CA. Threatened and endangered plant species recorded during the 1993 survey are also summarized. An annotated list of vascular plants (Appendix A) occurring at Horseshoe Lake CA, originally prepared by Huston (1972), was updated with the results of this survey.

Objectives

The objectives of this segment of the study were to: 1) characterize the species composition of herbaceous plant communities within Horseshoe Lake CA; and 2) determine the presence, location, and general distribution of state and federally listed threatened and endangered plant species.

Methods

Representative forest and non-forest plant communities identified from aerial photographs and National Wetlands Inventory data were visited beginning 9 May and ending 18 October, 1993. Systematic searches were conducted within individual plant communities to record the presence and relative abundance of vascular plant species. Relative abundance of individual species encountered were rated as: rare, 1-10 plants or 1-2 populations of a species; uncommon, 11-25 plants or 3-5 populations; common, 26-100 plants or 6-10 populations, and abundant > 100 plants or > 10 populations.

Intensive searches for threatened and endangered plant species were conducted within plant communities and microhabitats that were likely to harbor such species. Searches were only partially systematic, in that search efforts were concentrated mostly within sites where threatened and endangered plants were anticipated to occur. The relative abundance (see rating above) and locations where threatened and endangered plants were recorded and digitized on vegetation community maps. Individual sites were visited at least once per month through mid-July. Sites were revisited sporadically after mid-July when flooding by the Mississippi River inundated much of Horseshoe Lake CA.

Specimens of representative plant species found in each community were collected; however, no collections were made within the two Nature Preserves located on the area. All collections were pressed in the field and dried in an electric dryer at Southern Illinois University. Voucher specimens were deposited in the Illinois Natural History Survey Herbarium.

Plant identifications were made with the aid of Mohlenbrock (1986), Fernald (1950), Gleason and Cronquist (1991), and by referring to specimens in the Southern Illinois University at Carbondale Herbarium. Nomenclature followed Mohlenbrock (1986) for all groups except Panicum, which followed Gleason and Cronquist (1991).

Results

Plant Community Descriptions

Cypress/Tupelo Swamp.--This community was characterized by permanent to periodic flooding during the growing season, saturated or poorly drained soils, and primarily woody vegetation with low diversity of herbaceous species. This community was not restricted only to the forested portion of the lake, but was also found within the Island and Inland Woods Nature Preserves, and in the southeast quarter of sections 14 and northwest quarter of section 27, (T. 16 S., R. 2 W.). Taxodium distichum and Nyssa aquatica were the dominant overstory trees, with scattered Acer rubrum var. drummondii, Fraxinus profunda, and Quercus lyrata at the margins of these swamps. Shrubs found on fallen logs, cypress knees, dead stumps, or enlarged bases of trees included Itea virginica, Rosa palustris, and very rarely, Styrax americana. Cephalanthus occidentalis occurred in shallow water depths of up to 1 m, and often formed extensive stands along shallow shorelines. Herbaceous plants that occurred in Cypress/tupelo swamps included Boehmeria cylindrica, Bidens cernua and Bidens discoidea,

Lycopus rubellus, Pilea pumila, Scutellaria lateriflora, and Triadenum walteri. Aquatic plants such as Ceratophyllum demersum, Najas guadalupensis and N. minor, Potamogeton foliosus, Lemna spp., Spirodela spp., and Wolffia spp. were also common in Cypress/tupelo swamps.

Bottomland Forests.--Bottomland forests were widely distributed throughout Horseshoe Lake CA. This community was characterized by deciduous hardwood trees occupying periodically flooded habitats with poorly drained soils that were inundated or saturated during some portion of the growing season. A diverse array of trees occurred in bottomland forests, including Carya cordiformis, C. laciniosa, Liquidambar styraciflua, Ulmus rubra, Acer rubrum, Acer rubrum var. drummondii, Populus deltoides, Celtis laevigata, Quercus lyrata, Q. macrocarpa, Q. bicolor, Q. pagoda, Q. shumardii, Q. michauxii, Q. palustris, Q. phellos, Gleditsia triacanthos, Catalpa speciosa, Sassafras albidum, Fraxinus pennsylvanica, F. profunda, and Platanus occidentalis. Shrubs such as Cornus foemina, Itea virginica, Styrax americana, Ilex decidua, Forestiera acuminata, and Lindera benzoin were characteristically found in bottomland forests. Toxicodendron radicans was the most common vine in the bottomland community, with Vitis cinerea, V. palmata, Smilax hispida, Parthenocissus quinquefolia, Trachelospermum difforme, and Clematis crispa also found occasionally. Phoradendron serotinum and Polypodium polypodioides var. michauxianum formed a locally common canopy association on Ulmus rubra and other hardwoods in bottomland woods in the Island and Inland Woods Nature Preserves. Herbaceous vegetation consisted of a variety of Carex spp., most noteably C. intumescens, C. hyalinolepis, C. louisianica, C. lupulina, C. grayii, C. projecta, C. squarrosa, C. typhina, and C. normalis. Asclepias perennis, Boehmeria cylindrica, Iris fulva, Leersia spp., Scutellaria lateriflora, S. nervosa, Ranunculus septentrionalis, and Pilea pumila were also characteristic herbs of this community.

Mesic Forest.--Mesic forests were communities of hardwood trees with a well-developed understory usually and generally located on well-drained soils. Mesic forests occurred on elevated ridges that were interspersed within the bottomland forest. This community was found on the island and inland woods Nature Preserves, and in small patches at the margins of bottomland forests throughout the area. The canopy consisted of a number of tree species including Fagus grandifolia, Liriodendron tulipifera, Magnolia acuminata, Quercus alba, Quercus rubra, Quercus prinoides var. acuminata, Quercus velutina, Carya cordiformis, C. ovalis, C. glabra, Acer saccharum, Juglans nigra, and Tilia americana. Understory plants included

Aesculus pavia, Asimina triloba, Carpinus caroliniana, Cornus florida, Sassafras albidum, and Lindera benzoin. Toxicodendron radicans, Vitis cinerea, V. vulpina, Smilax glauca, S. hispida, and Parthenocissus quinquefolia were occasional vines in this community. The herbaceous layer was quite diverse and variable during the different stages of the growing season. Species that were seasonally common included Viola pubescens var. eriocarpa, V. sororia, Podophyllum peltatum, Athyrium angustum, A. pycnocarpon, Dentaria laciniata, Corydalis flavula, Sanicula gregaria, Scutellaria ovata, Polygonum virgininaum, Laportea canadensis, Botrychium virginianum, Poa sylvestris, Phacelia ranunculacea, Geum canadense, Osmorhiza longistylis, Cryptotaenia canadensis, Leersia virginica, Galium circaezans, G. triflorum, Phegopteris hexagonoptera, Asarum canadense var. reflexum, and Aster spp.

Marshes.--Marshes were a frequently encountered community at Horseshoe Lake CA, typically occurring at the edges of bottomland and mesic forests and crop fields. Marshes were non-woody, herbaceous communities on poorly drained soils that were periodically flooded or had saturated soils during some portion of the growing season. Herbaceous vegetation was quite diverse and varied seasonally. Eleocharis obtusa, E. macrostachya, Gratiola neglecta, Alopecurus carolinianus, Rorippa islandica, Heteranthera limosa, Sagittaria calycina, Scirpus americanus, Bacopa rotundifolia, Potamogeton diversifolius, Ludwigia peploides ssp. glabrescens, Ammannia coccinea, Rotala ramosior, Sagittaria brevirostra, Alisma plantago-aquatica, Echinodorus cordifolius, E. muricata, Leptochloa panicoides, Lindernia dubia, Ludwigia palustris var. americana, Senecio glabellus, Cyperus acuminatus, C. strigosus, Polygonum spp., Leersia oryzoides, Juncus spp., Hypericum mutilum, Phyla lanceolata, Sium suave, Boltonia asteroides, Bidens spp., and Hibiscus lasiocarpus were the most common floristic elements of this community.

Open Lakes and Ponds.--Open lakes and ponds included portions of Horseshoe Lake and shallow ponds that were mostly devoid of woody emergent vegetation. These communities were permanently flooded areas where the dominant vegetation consisted primarily of aquatic species. Plants found in this community included Nelumbo lutea, Pontederia cordata, Ludwigia leptocarpa, L.peploides, Acorus americanus, Heteranthera limosa, Erygnium prostratum, Alisma plantago-aquatica, Echinodorus cordifolius, Eragrostis hypnoides, Limnobium spongia, Ammannia coccinea, Rotala ramosior, Ceratophyllum demersum, Polygonum hydropiperoides, Typha latifolia, Najas

quadalupensis, N. minor, Potamogeton foliosus, P. diversifolius, Azolla mexicana, Lemna spp., Spirodela spp., and Wolffia spp.

Disturbed Areas.--Disturbed areas were widespread on Horseshoe Lake CA. These were areas heavily impacted by human activity and included cultivated crop fields, railroad right-of-ways, roadsides, and idle/old-field areas with a history of disturbance.

Crop fields, including cultivated and fallow fields, typically contained weedy plant species such as Cynanchum laeve, Sorghum halepense, Setaria faberi, S. glauca, Leptochloa filiformis, Ipomoea hederacea, I. purpurea, I. lacunosa, Amaranthus rudis, A. hybridus, Oenothera laciniata, Vicia cracca, V. villosa, Eleocharis obtusa, Gratiola neglecta, Cyperus iria, C. esculentus, Cardamine hirsuta, Sibara virginica, Brassica rapa, Arabidopsis thaliana, Cerastium vulgatum, Hordeum pusillum, Lathyrus hirsutus, Conyza canadensis, Allium vineale, Ranunculus abortivus, Rumex crispus, R. obtusifolius, Senecio glabellus, Veronica arvensis, V. peregrina, Lepidium virginicum, Myosotis verna, Erigeron annuus, E. philadelphicus, Lamium amplexicaule, L. purpureum, Polygonum pennsylvanicum, P. persicaria, Callitriche terrestris, Campsis radicans, and Krigia caespitosa.

Railroad right-of-ways occurred along the dam and spillway road, and Illinois Routes 127 and 3 within Horseshoe Lake CA. An interesting assemblage of native and exotic species was found in these areas. Common plants along right-of-ways included Conyza canadensis, Lactuca canadensis, L. floridana, Rhus glabra, Sassafras albidum, Ampelopsis cordata, Vitis vulpina, Galactia regularis, Melothria pendula, Clematis crispa, Broussonetia papyrifera, Morus alba, Ruellia strepens, Tradescantia ohiensis, T. subaspera, Cynodon dactylon, Helenium amarum, Campsis radicans, Brunnichia ovata, Saponaria officinalis, Solanum ptycanthum, Parthenocissus quinquefolia, and Toxicodendron radicans.

Roadsides, including ditches, provided habitat for numerous weedy and wetland species throughout the area. Weedy plants occurring along the drier portions of roadsides included Kummerowia striata, K. stipulacea, Medicago lupulina, Trifolium repens, T. campestre, T. hybridum, T. pratense, Arenaria serpyllifolia, Helenium amarum, Cynodon dactylon, Solidago canadensis, Apocynum cannabinum, Setaria glauca, Chamaesyce maculata, C. supina, Diodia virginiana, Asclepias syriaca, Festuca pratensis, Cirsium vulgare, C. discolor, Vernonia missurica, V. gigantea, Sorghum halepense, Paspalum pubiflorum, Mollugo verticillata, Sida

spinosa, and Bromus spp. Wetland species that inhabited wetter roadsides and ditches included Polygonum hydropiperoides, P. lapathifolium, Bidens spp., Sagittaria latifolia, Alisma plantago-aquatica, Sium suave, Ptilmnium costatum, Lysimachia nummularia, Juncus effusus, Mimulus alatus, Carex spp., Eragrostis hypnoides, Clematis crispa, Iris fulva, Cicuta maculata, and Hibiscus lasiocarpus.

Floristic Survey

The 1993 survey and Huston (1972) documented 682 vascular plant taxa at Horseshoe Lake CA (Appendix A). This survey recorded 161 new taxa, although several taxa recorded by Huston (1972) were not detected in 1993. Four species were found that were new to the Illinois flora: Brachiaria platyphylla, Sporobolus pyramidatus, Crepis pulchra, and Tagetes erecta.

Plant species known to occur at Horseshoe Lake from this and Hustons' (1972) survey represented 113 plant families. Of the 682 taxa, 15 were ferns or fern allies, 2 were gymnosperms, 204 were monocots, and 461 were dicots. Families with the greatest representation by individual taxa were Poaceae (77), Asteraceae (66), Cyperaceae (60), Fabaceae (27), Polygonaceae (21), Lamiaceae (20), and Rosaceae (20). The largest genera were Carex (36), Quercus (17), Polygonum (13), and Cyperus (9).

Threatened and Endangered Species

No federally threatened or endangered plant species were found during this survey, but 3 Illinois threatened (IL-T) and 11 Illinois endangered (IL-E) plant species were found within Horseshoe Lake CA by Herkert (1991). The following is a list of threatened, endangered, and rare plants, with pertinent location and collection information.

Carex intumescens Rudge (IL-E). This sedge occurs in forested wetlands and is known from scattered records in northern and southern Illinois. This species was occasional to common in bottomland forests at Horseshoe Lake CA (Figure 4-1) (MB 5232, 5238, 5318, and 5349).

Carex oxylepis Torrey & Hooker (IL-E). This sedge inhabits mesic and bottomland forests in southern Illinois. One population was discovered in a bottomland forest at Horseshoe Lake CA (Figure 4-1) (MB 5269).

Carex socialis Mohlenbrock & Schwegman. This sedge inhabits lowland woods. The species was previously reported as a rare occurrent in Johnson, Massac, Pulaski, and Union Counties in southern Illinois. Two small populations were

found in bottomland forest at Horseshoe Lake CA (Figure 4-1), one of which was on the Inland Woods Nature Preserve (MB 5282).

Styrax americana Lam. (IL-T). Storax is a species that inhabits floodplain forests and swamps in Illinois. The species was found to be uncommon in bottomland forests and swamp margins at Horseshoe Lake (Figure 4-2) (MB 5239).

Quercus nuttallii E.J. Palmer (IL-E): Nuttall's oak is known from both the island and inland woods nature preserves and from 1 large tree at the site manager's home at Horseshoe Lake (Figure 4-2). A specimen was collected from a large tree after a storm broke off several branches from the tree (MB 5356) to aid in identification, but no new sites were found.

Quercus phellos L. (IL-T): Willow oak is presently known from the island woods nature preserve at Horseshoe Lake. Several new sites were found in bottomland forests and woodland margins where the species was occasional to common during the 1993 survey (Figure 4-2) (MB 5265, 5288, 5327).

Scirpus hallii Gray (IL-E): Hall's bulrush was collected in a marsh at Horseshoe Lake (Figure 4-3) (MB 6042). This specimen was confirmed by examination of a collection by R.T. Rexroat (#17152) from Cass County in the southern Illinois University herbarium.

Leptochloa panicoides (Presl) Hitchcock (IL-E): Salt meadow grass was only known in Illinois from Calhoun and Pike counties until discovered in 1992 at the Horseshoe Lake dam and spillway (MB 3943). This site has since been destroyed, but another site was found in 1993 in a marsh where the plant was locally common (Figure 4-3) (MB 6080).

Melothria pendula L. (IL-E): The squirting cucumber is presently known from a railroad right-of-way near the Horseshoe Lake dam and spillway. Three new sites were found in 1993, all of which were in disturbed habitats (Figure 4-3). Two of the sites were along railroad right-of-ways, while the third site was along a roadside (MB 6014 and 7643). This species remains uncommon at Horseshoe Lake.

Eryngium prostratum Nuttall (IL-E): This species was previously known from one of the Nature Preserves at Horseshoe Lake CA. Another large population was found at the edge of a large marsh east of the Inland Woods Nature Preserve (Figure 4-4) (MB 5739).

Eupatorium incarnatum Walter (IL-E): This species of thoroughwort is only known in southern Illinois from mesic forests and swamps. The species was previously known to occur in both Nature Preserves at Horseshoe Lake. Three additional sites were found during this study at the edges of disturbed strips of woodlands (Figure 4-4). No specimens were collected.

Matelea gonocarpa (Walter) Shinners. Climbing milkweed is a rare woodland inhabitant, confined to the southern portion of Illinois. One small population was found in bottomland woods at Horseshoe Lake CA (Figure 4-4) (MB 5751).

Clematis crispa L. (IL-E): The blue jasmine is presently known in Illinois only from Horseshoe Lake. An intensive search in 1993 revealed it to be occasional to common in bottomland forests, woodland edges, and railroad right-of-ways at Horseshoe Lake CA (Figure 4-5). The population first discovered by Huston in 1969 is no longer extant (HS 510; MB 5230).

Iris fulva Ker. (IL-T): Swamp red iris was an occasional to common species in roadside ditches, lake edges, woodland margins, and bottomland forests at Horseshoe Lake (Figure 4-5) (HS 709; MB 5217).

Ptilimnium costatum (Elliott) Rafinesque (IL-E). Mock Bishop's weed was found to be common in bottomland forests, power line cuts, and woodland margins at Horseshoe Lake (Figure 4-6) (MB 6009).

Fimbristylis annua (All.) Roemer & Schultes (IL-E): Baldwin's fimbrystylis was previously known from the inland woods nature preserve and disturbed areas at Horseshoe Lake, although it was not found before the flood occurred in mid-July 1993.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON ENDANGERED, THREATENED, AND RARE PLANTS

Populations of endangered, threatened, and rare plants discovered at Horseshoe Lake CA primarily occurred on sites distant from areas likely to be impacted by increased lake level, or they occurred at topographic elevations above 324 feet MSL. The most vulnerable populations were of Carex intumescens, Scirpus hallii, and Clematis crispa located at the southern end of the southwest arm of the lake (Figures 4-1, 4-3, and 4-6). These sites, located between 324 and 325 feet MSL, would not be inundated by raising the lake

level, but they could be adversely impacted by subsurface water saturation, or if flooding frequency increases with higher lake levels. Larger, more widespread populations of Carex intumescens and Clematis crispa occurred elsewhere on Horseshoe Lake CA, so the threat to these species of increased lake levels is minimal. The Scirpus hallii site near the southwest arm (Figure 4-3) was located in a topographic depression, just below 325 feet MSL. The species is an annual that inhabits sandy sites where water levels are variable (Herkert 1991). Scirpus hallii survives wet and dry years by persisting in the seed bank. The species could be eliminated from Horseshoe Lake CA if increased lake levels produce a stabilized water regime at the single site where the species occurred.

Two other sites near the dam and picnic area on the southeast arm of the lake contained populations of Melothria pendula and Leptochloa panicoides (Figure 4-3). These sites would not be directly impacted by raising the lake level since they occurred below the spillway. The Leptochloa panicoides site was located at the outlet of the dam on Lake Creek, so could potentially be impacted by regulation of lake outflows. This was 1 of only 3 sites where the species was found on Horseshoe Lake CA.

The summer 1993 flood of Horseshoe Lake by the Mississippi River may have adversely impacted other endangered, threatened, and rare plant species throughout the study area. Herbaceous vegetation composition of lowland communities may also have been altered by the 1993 flood. We anticipate that hydrophytic species, particularly those that tolerate longer periods of inundation or soil saturation will be enhanced, at least in the short-term. More xerophytic species may have been at least temporarily lost from the area. Follow-up studies are needed during future growing seasons to determine impacts of the 1993 Mississippi River flood on herbaceous vegetation communities of Horseshoe Lake CA. Sites where endangered, threatened, and rare species were documented in this study should be revisited during the 1994 growing season to determine their persistence after flooding that occurred in summer 1993 and spring 1994.

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Figure 4-1. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.

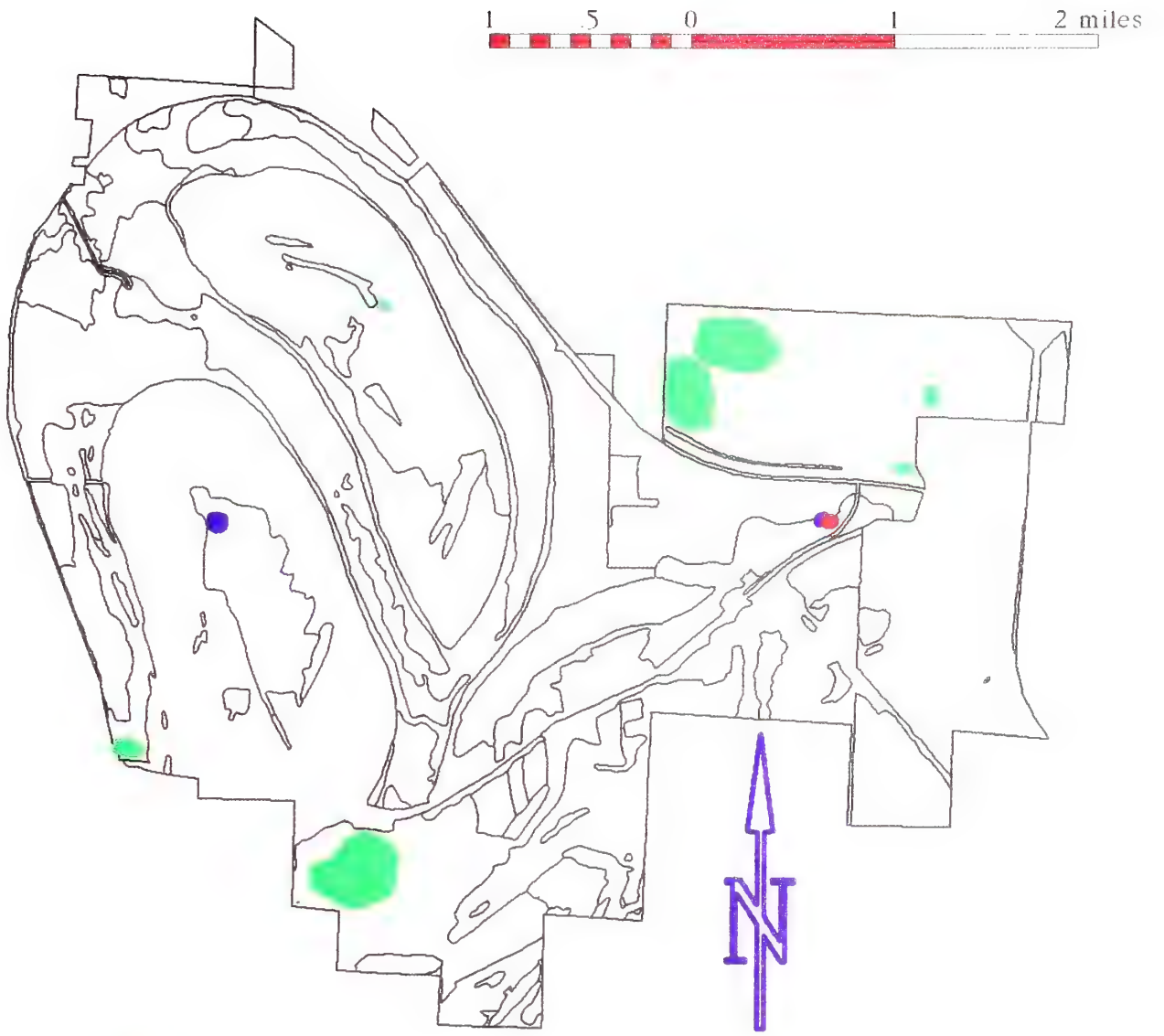

1 .5 0 1 2 miles
N
Carex intumescens
Carex oxylepis
Carex socialis

Figure 4-2. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.

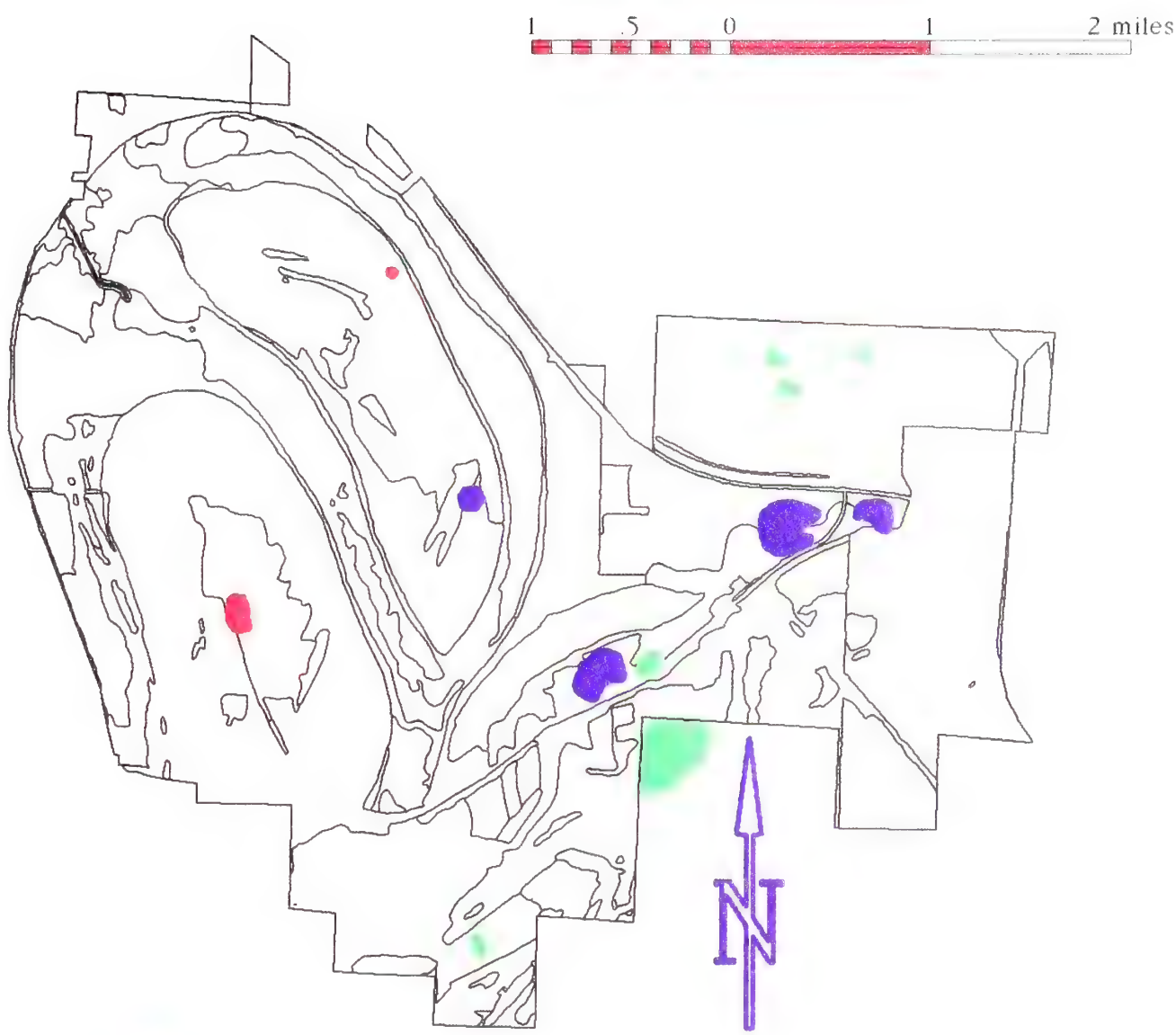
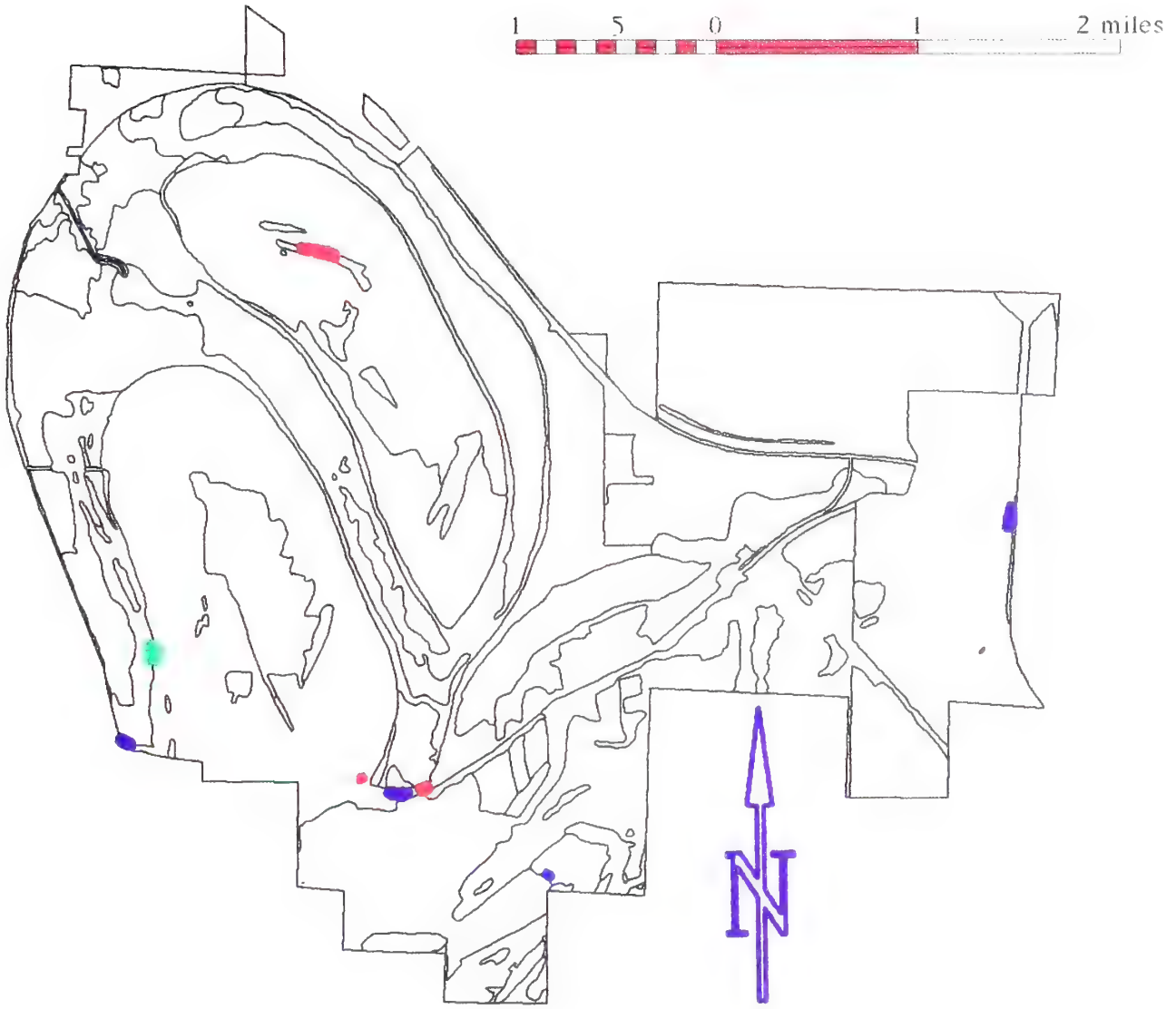

1 .5 0 1 2 miles
N
Styrax americana
Quercus nuttallii
Quercus phellos

Figure 4-3. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.

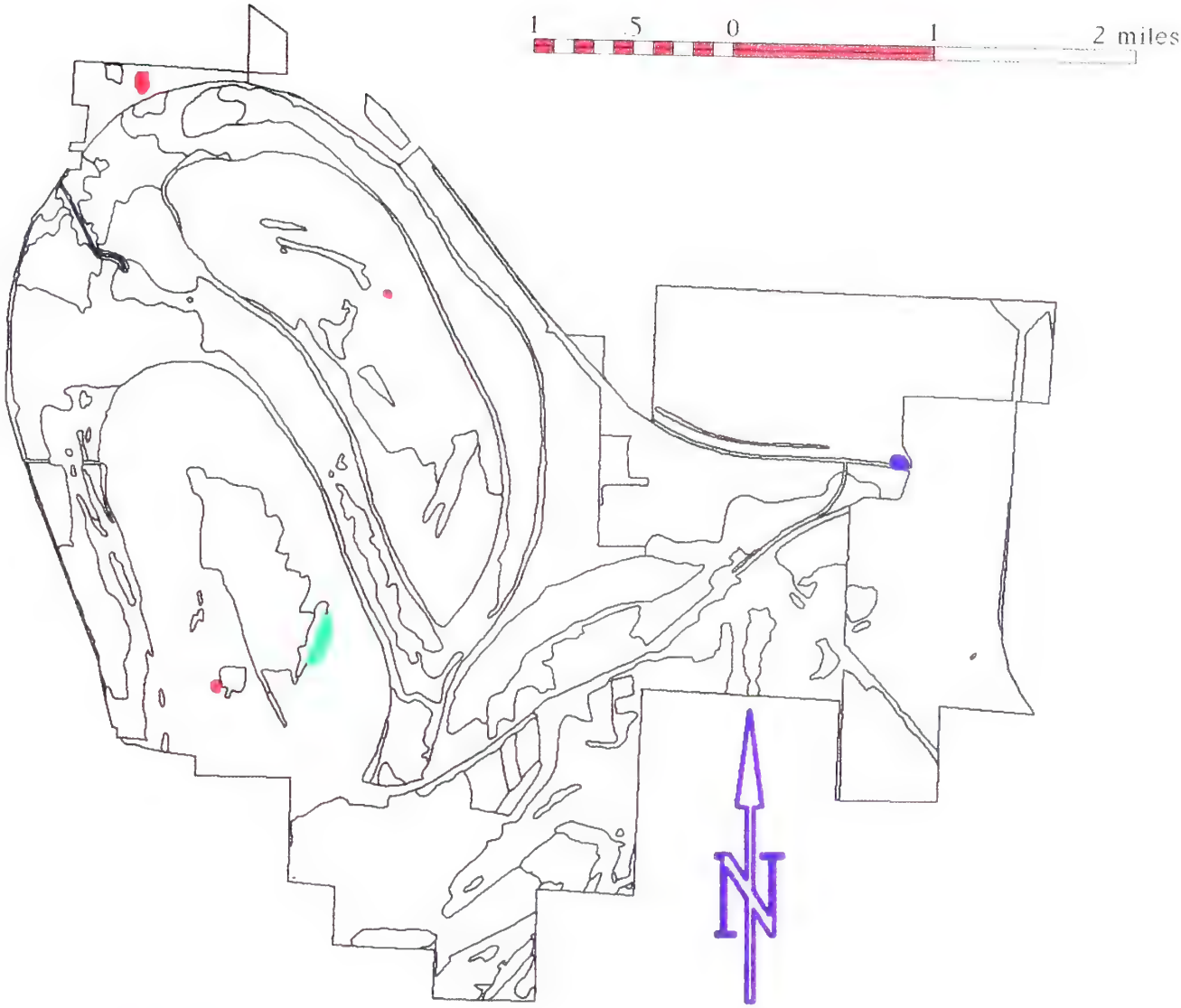


Scirpus hallii

Leptochloa panicoides

Melothria pendula

Figure 4-4. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.

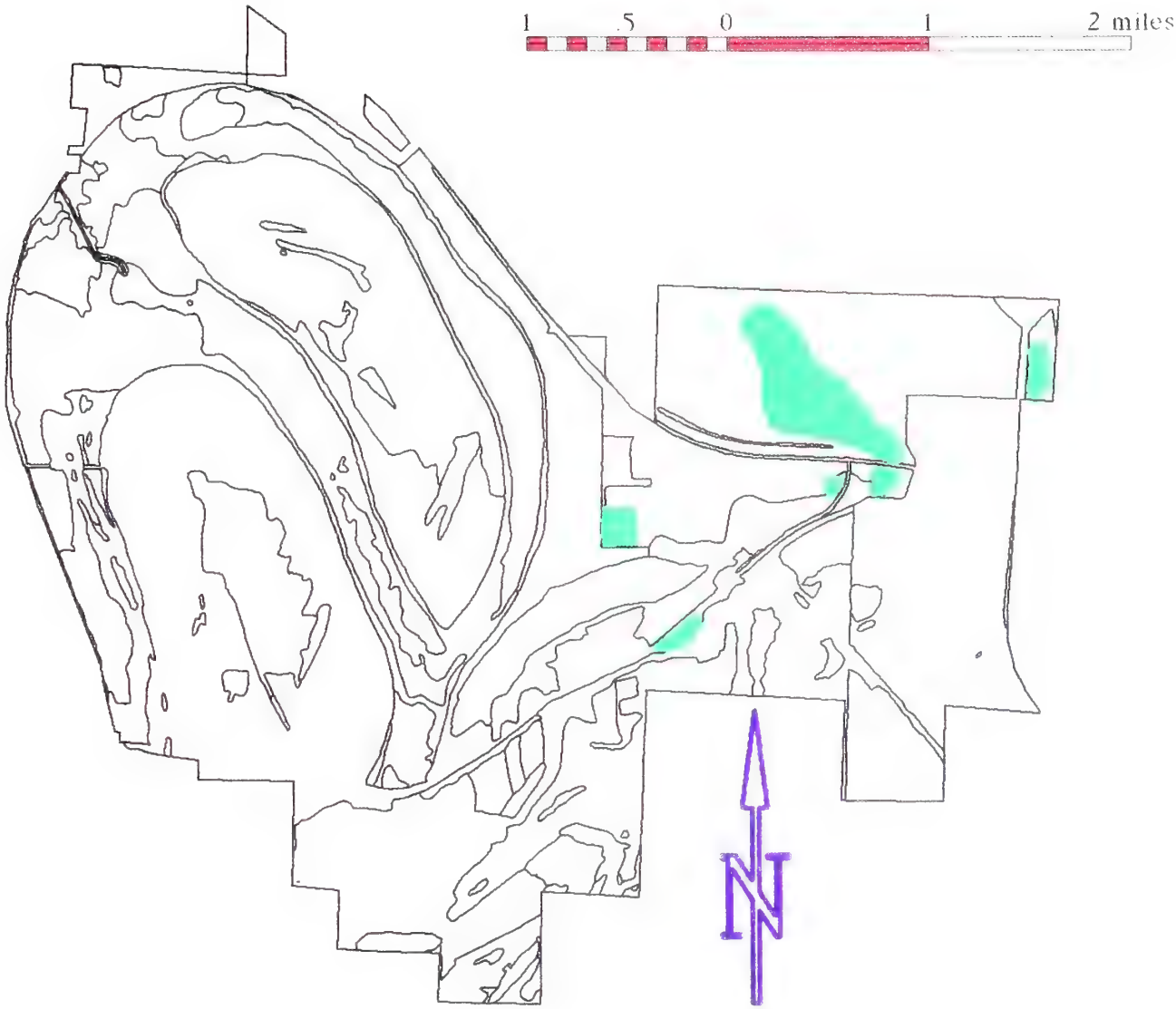


Eryngium prostratum

Eupatorium incarnatum

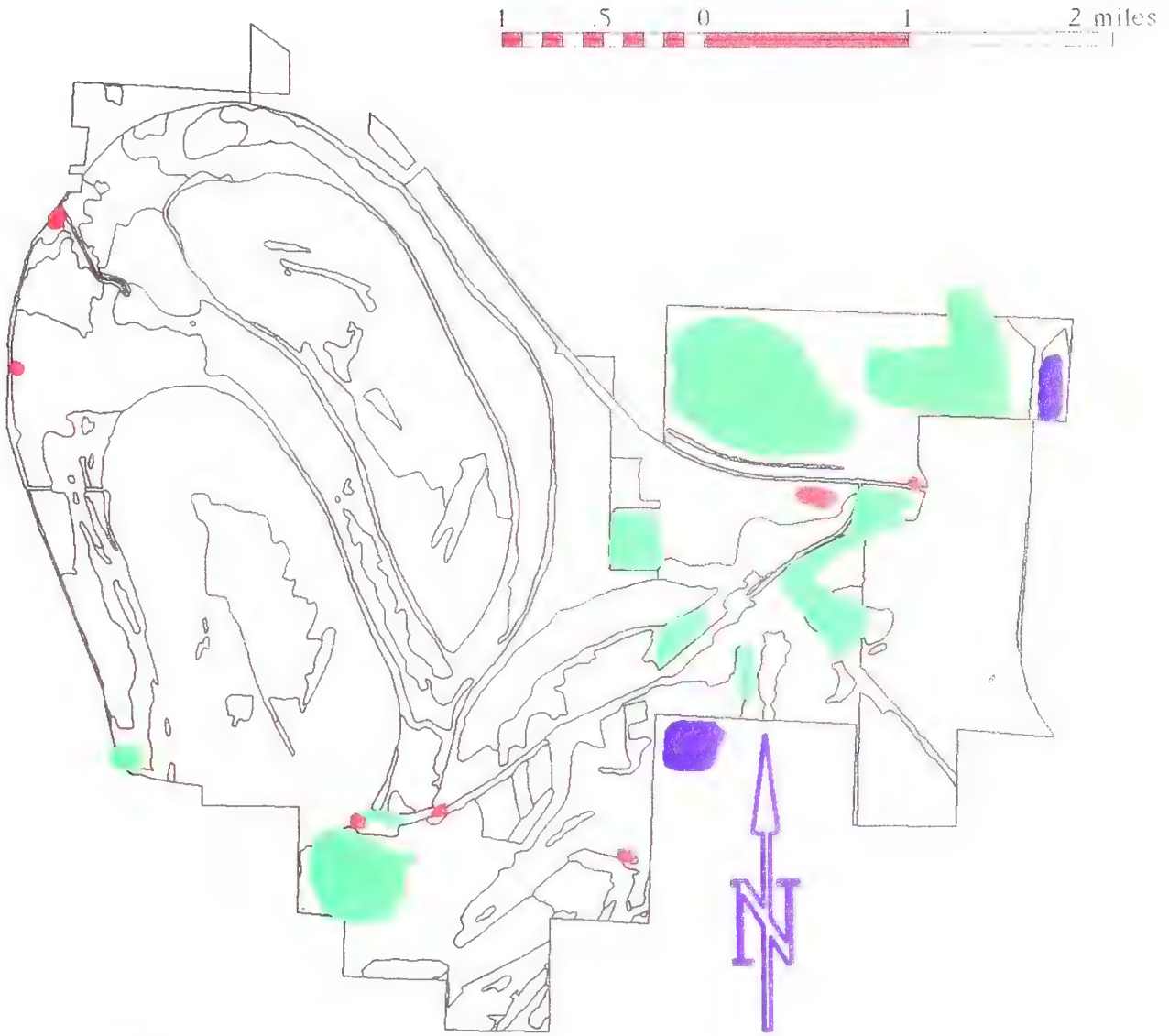
Matelea gonocarpa

Figure 4-5. Site locations where Ptilimnium costatum was found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.



Ptilimnium costatum

Figure 4-6. Site locations where 3 species of endangered, threatened, or rare plants were found during plant community surveys conducted at Horseshoe Lake Conservation Area during May - October, 1993.



Clematis crispa

Iris fulva

Clematis crispa / Iris fulva

Appendix 4-A. Annotated List of Vascular Plants

HS = Specimens deposited by Huston in the Southern Illinois University Herbarium.

MB = Specimens deposited by Basinger in the Illinois Natural History Survey Herbarium.

Equisetaceae

Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eaton. Wooded shorelines; uncommon; HS 956; MB 5732.

Ophioglossaceae

Botrychium dissectum Sprengel. var. *obliquum* (Muhl.) Clute. Mesic and floodplain woods; uncommon; HS 546.

Botrychium virginianum (L.) Swartz. Mesic and bottomland woods; common; HS 682.

Ophioglossum vulgatum L. var. *pseudopodum* (Blake) Farwell. Bottomland woods; rare; MB 5148.

Osmundaceae

Osmunda regalis L. var. *spectabilis* (Willd.) Gray Wet woods; uncommon; HS 124.

Adiantaceae

Adiantum pedatum L. Mesic woods; common; HS 123.

Polypodiaceae

Polypodium polypodioides (L.) Watt. var. *michauxianum* Weatherby Epiphytic on *Ulmus rubra* and decaying logs; uncommon; HS 662.

Thelypteridaceae

Phegopteris hexagonoptera (Michaux) Fee. Mesic woods; uncommon; HS 661.

Thelypteris palustris Schott var. *pubescens* (Laws.) Fernald Wet woods; rare; HS 668. Not seen by MB in 1993 survey.

Aspleniaceae

Asplenium platyneuron (L.) Oakes Roadsides and mesic woods; uncommon; HS 130.

Athyrium pycnocarpon (Sprengel) Tidestrom Mesic woods; uncommon, although locally common; HS 52.

Onoclea sensibilis L. Mesic woods; uncommon; HS 468.

Polystichum acrostichoides (Michaux) Schott Mesic woods; uncommon; HS 903.

Woodsia obtusa (Sprengel) Torrey Railroad right-of-way; uncommon; MB 5433.

Salviniaceae

Azolla mexicana Presl Floating aquatic in swamps; abundant; HS 400.

Taxodiaceae

Taxodium distichum (L.) Richard Swamps; abundant; HS 974.

Cupressaceae

Juniperus virginiana L. Old fields and edge of mesic woods; uncommon; HS 592.

Typhaceae

Typha latifolia L. Open shorelines and wet ditches; common; HS 332.

Najadaceae

Najas guadalupensis (Sprengel) Magnus Shallow water of swamps; common; MB 3268.

Najas minor All. Shallow water of swamps; common; HS 819.

Potamogetonaceae

Potamogeton diversifolius Raf. Shallow ponds and shorelines; common; HS 807; MB 5414.

Potamogeton foliosus Raf. Swamps; common; HS 224.

Alismaceae

Alisma plantago-aquatica L. var. *parviflorum* (Pursh) Torrey Open shorelines, marshes, wet ditches, and wet depressions in fields; common; HS 176; MB 6018.

Echinodorus berteroi (Sprengel) Fassett var. *lanceolatus* (Watson & Coulter) Fassett Marsh; uncommon; MB 6017.

Echinodorus cordifolius (L.) Griseb. Open shorelines and marshes; common; HS 178; MB 2995.

Sagittaria brevirostra Mackenzie & Bush Open shorelines, marshes, and wet areas in fields; common; HS 820; MB 5411.

Sagittaria calycina Engelm. Open shorelines, marshes, and wet ditches; common; HS 356; MB 5412.

Sagittaria latifolia Willd. Open shorelines and wet ditches; common. Not collected by MB in 1993 survey.

Hydrocharitaceae

Limnobium spongia (Bosc) Steudel Floating aquatic in swamps; common; HS 232.

Poaceae

Agrostis alba L. var. *palustris* (Hudson) Farwell Roadside ditches; uncommon; MB 5720.

Agrostis hyemalis (Walter) BSP. Fallow fields, railroad right-of-ways, and power line cuts; common; HS 715; MB 5263.

Alopecurus carolinianus Walter Fields; abundant; HS 640.

Andropogon virginicus L. Woodland edges, railroad right-of-ways, and old fields; common; HS 538; MB 7631.

Aristida oligantha Michaux Roadsides and railroad right-of-ways; rare; MB 7646.

Arundinaria gigantea (Walter) Chapman Woodland edges, mesic woods, and swamp edges; uncommon; HS 572.

Brachiaria platyphylla (Grisebach) Nash Fields, roadsides, marshes, and wet ditches; abundant; MB 7759.

Bromus commutatus Schrader Disturbed areas and railroad right-of way; common; HS 712.

Bromus hordeaceus L. Roadsides and other disturbed areas; uncommon; MB 5275.

Bromus inermis Leyss. Fallow fields and woodland edges; common; HS 833; MB 5435.

Bromus japonicus Thunberg Roadsides and disturbed woodland edges; uncommon; MB 5227.

Bromus pubescens Muhl. Railroad right-of-way; rare; MB 5260.

Bromus racemosus L. Fallow fields and roadsides; uncommon; HS 832.

Bromus secalinus L. Fallow fields, roadsides, and other disturbed areas; common; HS 782.

Bromus sterilis L. Roadsides; uncommon; MB 5273.

Bromus tectorum L. Roadsides, fallow fields, and other disturbed areas; common; MB 5032.

Chasmanthium latifolium (Michaux) Yates Floodplain woods and woodland edges; uncommon; MB 6007.

Cinna arundinacea L. Wet woods; common; HS 323.

Cynodon dactylon (L.) Persoon Roadsides; abundant; HS 878.

Dactylis glomerata L. Roadsides and woodland edges; common; HS 147.

Digitaria sanguinalis (L.) Scopoli Roadsides and cultivated fields; abundant; HS 483; MB 6076.

Echinochloa crus-galli (L.) Beauvois Wet fields, shorelines, and disturbed areas; common; HS 78; MB 3945.

Echinochloa muricata (Beauvois) Fernald Marshes and swamp edges; abundant; MB 6015.

Eleusine indica (L.) Gaertner Roadsides and other disturbed areas; common; HS 424.

Elymus villosus Muhl. Wet woods; uncommon; HS 746; MB 5731.

Elymus virginicus L. Bottomland woods and woodland edges; common; HS 842.

Elymus virginicus L. var. *submuticus* Hooker Woodland edges; uncommon; HS 300.

Eragrostis cilianensis (All.) Lut. Wet fields and woodland edges; common; HS 193; MB 6033.

Eragrostis frankii C.A. Meyer Shorelines and fallow fields; uncommon; HS 758.

Eragrostis hypnoides (Lam.) BSP. Shorelines; common; HS 413.

Eragrostis pectinacea (Michaux) Nees Roadsides; common; MB 6564.

Festuca obtusa Biehler Mesic-bottomland woods; uncommon; MB 5152.

Festuca pratensis Hudson Roadsides, old fields, and other disturbed areas; abundant; HS 937.

Festuca rubra L. Roadsides and mowed areas; uncommon; HS 814.

Glyceria striata (Lam.) Hitchcock Wet woods; common; HS 747.

Hordeum pusillum Nuttall Fallow fields, disturbed areas, and woodland edges; abundant; HS 701; MB 5743.

Leersia lenticularis Michaux Wet woods; common; HS 238.

Leersia oryzoides (L.) Swartz Shorelines, wet ditches, and wet woods; common; HS 355.

Leersia virginica Willd. Mesic and wet woods; common; HS 456.

Leptochloa fascicularis (Lam.) Gray Fallow fields; common; HS 830; MB 6039.

Leptochloa filiformis (Lam.) Beauvois Edges of fields and wet soil at spillway of dam; common; HS 248; MB 4424 and 6078.

Leptochloa panicoides (Presl) Hitchcock Marshes and wet soil at the margin of the dam and spillway; uncommon, although locally common; MB 3943 and 6080.

Lolium multiflorum Lam. Wet fields; uncommon; MB 5218.

Lolium perenne L. Roadsides and fields; uncommon; MB 5897.

Muhlenbergia schreberi J.F. Gmelin Mowed lawns, roadsides, and railroad right-of-ways; common; MB 7630.

Panicum boscii Poiret Railroad right-of-way. Rare; MB 5258.

Panicum capillare L. Field edges; common; HS 192.

Panicum clandestinum L. Woodland edge; uncommon; MB 5437.

Panicum dichotomiflorum Michaux Fields, roadsides, and railroad right-of-ways; abundant; HS 908; MB 7635.

Panicum lanuginosum Ell. var. *implicatum* (Scribner) Fernald Wet ditch along railroad right-of-way and power line cut; uncommon; HS 802.

Panicum lanuginosum Ell. var. *lindheimeri* (Nash) Fernald Wet fields and power line cuts; common; HS 769.

Panicum microcarpon Muhl. Floodplain forests; uncommon; MB 5270.

Panicum rigidulum Bosc Open shorelines; uncommon; HS 895.

Paspalum ciliatifolium Michaux Wet ditches, roadsides, and railroad right-of-ways; uncommon; HS 940; MB 7645.

Paspalum ciliatifolium Michaux var. *muhlenbergii* (Nash) Fernald Wet ditch; rare; HS 939.

Paspalum ciliatifolium Michaux var. *stramineum* (Nash) Fernald Mesic woods; uncommon; HS 122.

Paspalum fluitans (Ell.) Kunth Open shorelines; uncommon; HS 369.

Paspalum laeve Michaux Fields, roadsides, and other disturbed areas; uncommon. Not collected by MB in 1993.

Paspalum pubiflorum Rupr. var. *glabrum* Vasey. Shorelines; common; HS 459; MB 6730.

Phalaris arundinacea L. Roadside ditches; uncommon; MB 5277.

Phleum pratense L. Field edges; common; HS 794; MB 5721.

Poa annua L. Fallow fields and roadsides; common; HS 621.

Poa compressa L. Roadsides; common; MB 5354.

Poa pratensis L. Roadsides and other disturbed areas; common; HS 655.

Poa sylvestris Gray Mesic woods and swamp edges; common; MB 5024.

Setaria faberi Herrmann Fallow fields and roadsides; abundant; HS 835; MB 6075.

Setaria glauca (L.) Beauvois Roadsides; abundant; HS 416; MB 6037 and 6077.

Setaria viridis (L.) Beauvois Roadsides; uncommon; MB 6013.

Setaria viridis (L.) Beauvois var. *major* (Gaudin) Pospichal Roadsides; rare; MB 6092.

Sorghum bicolor (L.) Moench Roadsides and cultivated fields; uncommon. Not collected by MB in 1993.

Sorghum halepense (L.) Persoon Fields; abundant; HS 36.

Sphenopholis obtusata (Michaux) Scribner Bottomland woods; uncommon; MB 5169.

Sporobolus pyramidatus (Lam.) Hitchcock Roadsides; uncommon, although locally common; MB 6568.

Sporobolus vaginiflorus (Torrey & Gray) Wood Roadsides and railroad right-of-ways; uncommon; MB 7644.

Tridens flavus (L.) Hitchcock Roadsides, fields, and railroad right-of-ways; common; MB 7627.

Triticum aestivum L. Woodland edges, roadsides, and waste areas; common; MB 5348.

Vulpia myuros (L.) K. Gmelin Old roadside below power line cut; rare, although locally common; MB 5267.

Cyperaceae

Carex amphibola Steudel Wet woods; uncommon; HS 689. Not seen by MB in 1993 survey.

Carex annectens Bicknell Wet ditches and marshes; common; MB 5147, 5221, 5418, and 5429.

Carex bebbii (Bailey) Fernald Marshes; common; MB 5894 and 5904.

Carex blanda Dewey Roadsides, woodland margins, and bottomland forests; common; HS 629; MB 5034.

Carex brevior (Dewey) Mackenzie Wet ditches and disturbed areas; uncommon; HS 803.

Carex caroliniana Schweinitz Bottomland forests, disturbed areas, and fallow fields; common; HS 697a; MB 5338.

Carex cephalophora Willd. Wet ditches, roadsides, and woodland margins; common; HS 669; MB 5417.

Carex conjuncta Boott Wet ditch; uncommon; MB 5170, 5401, and 5419.

Carex crus-corvi Shuttleworth Wet ditches, field margins, and bottomland forests; common; HS 765 and 966; MB 5220 and 5734.

Carex davisii Schweinitz & Torrey Mesic woods at edge of lake; uncommon; MB 5013.

Carex frankii Kunth Woodland edges and roadside ditches, uncommon; HS 704; MB 5337.

Carex gracilescens Steudel Mesic and bottomland woods; uncommon; MB 5319, 5323, and 5359.

Carex gracillima Schweinitz Mesic woods; rare; MB 5366.

Carex granularis Willd. Wet ditches, woodland edges, and bottomland forests; common; HS 671; MB 5168, 5320, and 5339.

Carex grayii Carey Wet woods and swamp margins; common; HS 687 and 848; MB 5035.

Carex grisea Wahlenberg Wet ditches and mesic woods; common; MB 5009, 5299, 5364, and 5370.

Carex hyalinolepis Steudel Wet ditches, woodland edges, and shorelines; abundant; HS 667; MB 5007.

Carex intumescens Rudge Bottomland forests; common; MB 5232, 5238, 5318, and 5349.

Carex jamesii Schweinitz Mesic and wet woods; uncommon, although locally common; HS 688; MB 5029.

Carex lanuginosa Michaux Wet area under a power line cut; uncommon; MB 5268.

Carex laxiflora Lam. Mesic and bottomland woods; uncommon; MB 5316.

Carex louisianica Bailey Bottomland woods and woodland margins; common; HS 843; MB 5315 and 5400.

Carex lupuliformis Dewey Wet ditches and swamp margins; uncommon; MB 5886 and 6019.

Carex lupulina Willd. Wet ditches and woodland margins; uncommon; HS 703; MB 5729.

Carex muskingumensis Schweinitz Bottomland woods; uncommon; MB 5237.

Carex normalis Mackenzie Mesic and bottomland woods and roadsides; common; MB 5355.

Carex oxylepis Torrey & Hooker Bottomland woods; rare; MB 5269.

Carex projecta Mackenzie Bottomland woods and wet ditches; common; MB 5724 and 6006.

Carex rosea Willd. Mesic woods; uncommon, although locally common; HS 659; MB 5012.

Carex socialis Mohlenbrock & Schwegman Bottomland woods; rare; MB 5282.

Carex sparganioides Willd. Bottomland woods and wet ditches; uncommon; MB 5167 and 5240.

Carex squarrosa L. Bottomland woods and ditches; common; HS 720; MB 5241.

Carex stipata Muhl. Lake edge; uncommon; MB 5171 and 5321.

Carex tribuloides Wahlenberg Wet woods and disturbed areas; common; HS 749; MB 5722 and 5723.

Carex typhina Michaux Bottomland woods; uncommon; MB 5236.

Carex vulpinoidea Michaux Open shorelines, wet ditches, and old fields; common; HS 764.

Cyperus acuminatus Torrey & Hooker Fields and ditches; common; HS 201; MB 5325, 5415, and 5424.

Cyperus aristatus Rottb. Wet ditches, fallow fields, and open shorelines; common; HS 69.

Cyperus densicaespitosus Mattf. & Kukenth. Open, grassy shorelines; uncommon; HS 252.

Cyperus engelmannii Steudel Decaying logs in swamp, swamp edge, and fields; uncommon; HS 404; MB 7748.

Cyperus erythrorhizos Muhl. Wet fields and ditches; common; HS 363.

Cyperus esculentus L. Fields and shorelines; abundant; HS 161; MB 5741 and 6036.

Cyperus iria L. Wet ditches, fields, and waterways; common; HS 963; MB 6005 and 6029.

Cyperus ovularis (Michaux) Torrey Old fields and railroad right-of-ways; common; HS 396; MB 5715.

Cyperus strigosus L. Fallow fields, ditches, and other disturbed areas; common; HS 73; MB 6044.

Eleocharis acicularis (L.) R. & S. Shorelines and wet ditches; common; HS 253.

Eleocharis macrostachya Britton Wet ditches and marshes; common; MB 5744 and 6093.

Eleocharis obtusa (Willd.) Schultes Shorelines, wet ditches, and fallow fields; abundant; HS 388.

Eleocharis obtusa (Willd.) Schultes var. *detonsa* (Gray) Drapalik & Mohlenbrock Fields, marshes, ditches, and lake edges; abundant; MB 5301, 5733, and 5895.

Eleocharis smallii Britton Marshes and roadsides; uncommon; MB 6088.

Eleocharis verrucosa (Svenson) Harms Wet area in power line cut and woodland edge; uncommon, although locally abundant; MB 5262 and 5283.

Fimbristylis annua (All.) R. & S. Fallow field and forested swamp; rare; HS 200. Not seen by MB in 1993 survey.

Fimbristylis autumnalis (L.) R. & S. Wet fields, ditches, and shorelines; common; HS 70.

Scirpus americanus Persoon Marshes, edges of shallow pond, and fallow fields; abundant; HS 862; MB 5363 and 6016.

Scirpus atrovirens Willd. Wet ditches and woodland edges; uncommon HS 773.

Scirpus cyperinus (L.) Kunth Wet ditches; rare; HS 932.

Scirpus fluviatilis (Torrey) Gray Marsh; rare; MB 6081.

Scirpus hallii Gray Marsh; rare; MB 6042.

Scirpus koilolepis (Steudel) Gleason Fallow field; uncommon, although locally common; MB 5019.

Scirpus pendulus Muhl. Edge of a field; rare; MB 5252.

Araceae

Acorus americanus (Raf.) Raf. Open shorelines and shallow ponds; uncommon; HS 690; MB 5225.

Arisaema dracontium (L.) Schott Mesic and bottomland woods; common; HS 685.

Arisaema triphyllum (L.) Schott Mesic and bottomland woods; common; HS 613.

Lemnaceae

Lemna minor L. Floating aquatic in swamps; common; HS 811.

Lemna obscura (Austin) Daubs. Floating aquatic in swamps; uncommon; MB 5129.

Lemna perpusilla Torrey Floating aquatic in shallow ponds and swamps; common; HS 864.

Spriodela polyrhiza (L.) Schleiden Floating aquatic in swamps; abundant; HS 810.

Spirodela punctata (Mey.) C.H. Thompson Floating aquatic in swamps; abundant; HS 809.

Wolffia braziliensis Weddell Floating aquatic in swamps; common; HS 808.

Wolffia columbiana Karst. Floating aquatic in swamps; abundant; HS 401.

Wolffiella floridana (J.D. Smith) C.H. Thompson Submersed aquatic in swamps; rare; HS 691. Not seen by MB in 1993 survey.

Commelinaceae

Commelina communis L. Roadsides; uncommon; HS 869; MB 5727.

Commelina diffusa Burman f. Wooded shorelines and fields; occasional; HS 254; MB 6729.

Commelina erecta L. Railroad right-of-way; rare; HS 869. Not seen by MB in 1993 survey.

Commelina virginca L. Wooded shorelines and mesic-bottomland woods; common; HS 921.

Tradescantia ohiensis Raf. Power line and railroad right-of-ways; uncommon; MB 5249 and 5251.

Tradescantia subaspera Ker Railroad right-of-way; uncommon; MB 6221.

Pontederiaceae

Heteranthera limosa (Swartz) Willd. Wet fields and shorelines; abundant; HS 738; MB 5243.

Pontederia cordata L. Shorelines and shallow water of swamps; common; HS 101; MB 2997.

Juncaceae

Juncus acuminatus Michaux Marshes, wet ditches, and field margins; uncommon; MB 6046.

Juncus biflorus Ell. Wet fields; common; HS 767.

Juncus brachycarpus Engelm. Wet fields; uncommon; HS 954.

Juncus bufonius L. Roadside; uncommon; MB 5214.

Juncus diffusissimus Buckley Marshes; uncommon; MB 6045.

Juncus effusus L. var. *solutus* Fernald Wet ditches; common; HS 301; MB 5309.

Juncus interior Wiegand Wet ditches; uncommon; HS 714a.

Juncus marginatus Rastk. Wet fields; common; HS 768; MB 5326 and 6043.

Juncus tenuis Willd. Old fields, roadsides, and ditches; common; HS 714.

Liliaceae

Allium canadense L. Bottomland forests, disturbed areas, and railroad right-of-way; common; HS 711.

Allium vineale L. Woodland edges and fields; abundant; HS 729; MB 5903.

Asparagus officinalis L. Fence rows; uncommon; HS 481; MB 5890.

Erythronium albidum Nuttall Mesic woods; uncommon; HS 611.

Hemerocallis fulva L. Roadsides; common; HS 734.

Hymenocallis caroliniana (L.) Herbert Swamp edges and bottomland forests; uncommon; HS 964.

Lilium michiganense Farwell Bottomland woods; rare. Not collected by MB in 1993 survey.

Polygonatum commutatum (Schultes) Dietr. Mesic woods; uncommon; HS 950.

Smilacina racemosa (L.) Desf. Mesic woods; uncommon; MB 5026.

Trillium recurvatum Beck Mesic and bottomland woods; uncommon; HS 587.

Uvularia sessilifolia L. Bottomland woods; uncommon; MB 5235.

Smilacaceae

Smilax bona-nox L. Woodland edges and shorelines; common; HS 18.

Smilax ecirrhata (Engelm.) S. Watson Woodland edge; rare; HS 686.

Smilax glauca Walter Mesic and bottomland woods; common; HS 979.

Smilax hispida Muhl. Bottomland woods and woodland edges; abundant; HS 334.

Smilax pulverulenta Michaux Bottomland woods; rare; MB 5233.

Smilax rotundifolia L. Bottomland woods and woodland edges; common; HS 24.

Dioscoreaceae

Dioscorea quaternata (Walter) J.F. Gmelin Mesic woods and wooded banks; common; HS 135.

Dioscorea villosa L. Mesic woods and woodland edges; uncommon; HS 755; MB 6026.

Iridaceae

Iris fulva Ker Wet ditches, swamp edges, and open bottomland woods; uncommon; HS 709; MB 5217.

Iris shrevei Small Bottomland woods; rare; MB 5255.

Sisyrinchium angustifolium Miller Mesic and bottomland woods, roadsides, and disturbed areas; common; HS 509; MB 5033.

Orchidaceae

Aplectrum hyemale (Muhl.) Torrey Mesic woods; uncommon; HS 551. Not seen by MB in 1993 survey.

Platanthera peramoena (Gray) Gray Wet woods; uncommon; HS 827.

Triphora trianthophora (Swartz) Rydberg Mesic woods; rare; HS 263. Not seen by MB in 1993 survey.

Saururaceae

Saururus cernuus L. Swamp edges, bottomland woods, and wet ditches; common; HS 127; MB 5719.

Salicaceae

Populus deltoides Marshall Wet woods and shorelines; common; HS 298; MB 5302.

Populus heterophylla L. Wet woods and swamps; uncommon; HS 288.

Salix caroliniana Michaux Swamp edge; rare; MB 5276.

Salix exigua Nuttall Wooded shorelines; uncommon; HS 359.

Salix nigra Marshall Wooded shorelines, bottomland forests, and swamps; common; HS 637; MB 5306.

Juglandaceae

Carya aquatica (Michaux f.) Nuttall Wooded shoreline and swamp edges; uncommon; HS 872; MB 6021.

Carya cordiformis (Wang.) K. Koch Mesic woods and swamp edges; common; HS 6; MB 5336.

Carya glabra (Miller) Sweet Mesic woods; uncommon; HS 897; MB 5328.

Carya illinoensis (Wang.) K. Koch Mesic woods and swamp edges; common; HS 475.

Carya laciniosa (Michaux) Loud. Wet woods; common; HS 242.

Carya ovalis (Wang.) Sargent Mesic woods; common; HS 896.

Carya ovata (Miller) K. Koch Mesic woods; uncommon; HS 898.

Carya tomentosa (Poiret) Nuttall Bottomland woods; uncommon; MB 6011.

Juglans nigra L. Mesic woods and woodland edges; uncommon; HS 148.

Betulaceae

Betula nigra L. Shorelines and wet woods; common; HS 917.

Carpinus caroliniana Walter Mesic and bottomland woods; common; HS 273; MB 5351.

Corylus americana Walter Woodland edges; uncommon; HS 469.

Fagaceae

Fagus grandifolia Ehrh. var. *caroliniana* (Loud.) Fernald & Rehder Mesic-bottomland woods; common; HS 268.

Quercus alba L. Mesic woods; common; HS 554.

Quercus bicolor Willd. Wet woods; common; MB 5322.

Quercus X *byarsii* Sudw. Woodland edge; rare; HS 978. Hybrid of *Q. macrocarpa* and *Q. michauxii*.

Quercus X *heterophylla* Michaux f. Bottomland woods; uncommon; MB 5333. Hybrid of *Q. phellos* and *Q. rubra*.

Quercus X *hillii* Trelease Woodland edge; rare. Not collected by HS and not seen by MB in 1993 survey.

Quercus imbricaria Michaux Mesic and bottomland woods; uncommon; MB 5360.

Quercus lyrata Walter Wet woods; common; HS 270; MB 5279.

Quercus macrocarpa Michaux Wet woods; common; HS 211 and 951; MB 5278.

Quercus michauxii Nuttall Mesic and bottomland woods; common; HS 239; MB 5332.

Quercus nuttallii E.J. Palmer Wet woods; rare; HS 536; MB 5356.

Quercus pagoda Raf. Wet woods; common; HS 535; MB 5272.

Quercus palustris Muenchh. Wet woods; common; MB *7841*.

Quercus phellos L. Wet woods; uncommon, although locally common; HS 981; MB 5265, 5288, and 5327.

Quercus prinoides Willd. var. *acuminata* (Michaux) Gleason Mesic woods; uncommon; HS 374; MB 5335.

Quercus rubra L. Mesic woods; common; HS 557.

Quercus shumardii Buckley Mesic and bottomland woods; common; HS 375; MB 5271.

Quercus velutina Lam. Mesic woods and woodland margins; uncommon; HS 911.

Ulmaceae

Celtis laevigata Willd. Wet woods and shorelines; abundant; HS 88; MB 5436.

Ulmus alata Michaux Woodland edges; uncommon; HS 243.

Ulmus americana L. Wet woods and shorelines; uncommon; HS 23.

Ulmus rubra Muhl. Wet woods and shorelines; common; HS 21.

Moraceae

Broussonetia papyrifera (L.) Vent. Fallow field and railroad right-of-way; uncommon, although locally common; HS 887; MB 5224.

Humulus lupulus L. Woodland edge; uncommon; MB 6084.

Maclura pomifera (Raf.) Schneider Fence rows; uncommon; HS 970.

Morus alba L. Woodland edges and railroad right-of-way; uncommon; HS 653.

Morus rubra L. Mesic and bottomland woods; common; HS 531.

Urticaceae

Boehmeria cylindrica (L.) Swartz Bottomland forests, logs in swamps, and wet ditches; common; HS 61.

Boehmeria cylindrica (L.) Swartz var. *drummondiana* (Weddell) Weddell Old field; rare; HS 913.

Laportea canadensis (L.) Weddell Mesic and bottomland woods; uncommon, although locally common; HS 490.

Parietaria pensylvanica Muhl. Edges of woods and roadsides; uncommon; HS 776.

Pilea fontana (Lunell) Rydberg Woodland edge; uncommon; MB 7796.

Pilea pumila (L.) Gray Mesic and bottomland woods and logs in swamps; common; HS 501.

Urtica chamaedryoides Pursh Lake and roadside edge; uncommon, although locally common; MB 5027.

Viscaceae

Phoradendron serotinum (Raf.) I.M. Johnston On *Ulmus rubra* and *Quercus* spp. in bottomland woods; uncommon; HS 562.

Aristolochiaceae

Aristolochia serpentaria L. Mesic woods; rare; MB 5367.

Asarum canadense L. var. *reflexum* (Bicknell) Robinson Mesic woods; uncommon; HS 259.

Polygonaceae

Brunnichia ovata (Walter) Shinners Swamp edges, railroad right-of-ways, and wooded shorelines; common; HS 408.

Polygonum amphibium L. Wooded shorelines; uncommon; HS 885.

Polygonum arenastrum Boreau Fields and roadsides; common; MB 5216.

Polygonum bicorne Raf. Marshes and open shorelines; uncommon; HS 821; MB 6079.

Polygonum cespitosum Blume var. *longisetum* (DeBruyn) Stewart Open shorelines, lake edges, and mowed disturbed areas; common; HS 255.

Polygonum convolvulus L. Woodland edges; uncommon; HS 910. Not seen by MB in 1993 survey.

Polygonum cristatum Engelm. & Gray; Railroad right-of-ways; common; MB 7642.

Polygonum hydropiper L. Wooded shorelines and marshes; uncommon; HS 496.

Polygonum hydropiperoides Michaux Shallow water of swamps, lake edges, and marshes; common; HS 520; MB 3946.

Polygonum lapathifolium L. Wet ditches, fields, marshes, and shorelines; abundant; HS 385; MB 5413 and 5740.

Polygonum pensylvanicum L. Wet fields, marshes, and shorelines; abundant; HS 149.

Polygonum persicaria L. Fields and wooded shorelines; common; HS 947; MB 6735.

Polygonum punctatum Elliott Wet ditches, marshes, woodlands, and shorelines; common; HS 289; MB 6087.

Polygonum scandens L. Woodland edges; uncommon; HS 296.

Polygonum virginianum L. Mesic woods; uncommon; HS 57A.

Rumex acetosella L. Cultivated fields; common; HS 742; MB 6089.

Rumex altissimus Wood Woodland edge; uncommon; MB 5211.

Rumex crispus L. Fields and shorelines; abundant; HS 102; MB 5718.

Rumex crispus L. X *R. obtusifolius* L. Field and marsh edge; uncommon, although locally common; MB 6095.

Rumex mexicanus Meisner Mesic woods; uncommon; HS 757. Not seen by MB in 1993 survey.

Rumex obtusifolius L. Fields and woodland edges; common; HS 865; MB 5222.

Rumex verticillatus L. Bottomland forests and open shorelines; common; HS 759; MB 5314.

Chenopodiaceae

Chenopodium album L. Fields, roadsides, and other disturbed areas; common; HS 761.

Chenopodium ambrosioides L. Woodland margins and roadsides; uncommon; MB 7783.

Chenopodium glaucum L. Railroad right-of-way; rare; HS 394. Not seen by MB in 1993 survey.

Amaranthaceae

Amaranthus hybridus L. Edge of cultivated field; common; MB 6734.

Amaranthus rudis Sauer Fields and roadsides; abundant; HS 357; MB 7649.

Amaranthus spinosus L. Cultivated fields and other disturbed areas; uncommon; HS 881; MB 6098.

Froelichia gracilis (Hooker) Moq. Railroad right-of-way; rare; MB 7780.

Nyctaginaceae

Mirabilis nyctaginea (Michaux) MacM. Railroad right-of-ways; uncommon; MB 5160.

Phytolaccaceae

Phytolacca americana L. Mesic and bottomland forests, woodland edges, and shorelines; common; HS 40.

Molluginaceae

Mollugo verticillatus L. Cultivated fields and roadsides; abundant; HS 448.

Portulacaceae

Claytonia virginica L. Mesic woods; uncommon, although locally abundant; HS 583.

Portulaca oleracea L. Field edges and roadsides; common; HS 324.

Caryophyllaceae

Agrostemma githago L. Cultivated fields; uncommon; HS 717. Not seen by MB in 1993 survey.

Arenaria serpyllifolia L. Roadsides and railroad right-of-ways; common; HS 623; MB 5015.

Cerastium glomeratum Thuill. Fields and roadsides; common; HS 595.

Cerastium nutans Raf. Roadsides and fallow fields; uncommon; HS 638.

Cerastium vulgatum L. Fields, roadsides, and other disturbed areas; common; HS 604.

Dianthus armeria L. Railroad right-of-way; uncommon; MB 5434.

Holosteum umbellatum L. Fields and roadsides; common; HS 628.

Paronychia fastigiata (Raf.) Fernald Field edges and railroad right-of-ways; uncommon; HS 449.

Sagina decumbens (Elliott) Torrey & Gray Fields; common; HS 655; MB 5162.

Saponaria officinalis L. Roadsides and railroad right-of-ways; uncommon; HS 563; MB 6100.

Silene antirrhina L. Cultivated fields, roadsides, and railroad right-of-ways; common; HS 676.

Stellaria media (L.) Vill. Mowed lawns, fields, and roadsides; abundant; HS 591.

Ceratophyllaceae

Ceratophyllum demersum L. Shallow water of swamps and open lakes; abundant; HS 84.

Nelumbonaceae

Nelumbo lutea (Willd.) Persoon Shallow water of marshes and open lakes; abundant; MB 5738.

Ranunculaceae

Actaea pachypoda Elliott Mesic woods; rare; HS 857.

Clematis crispa L. Bottomland woods and railroad right-of-ways; uncommon; HS 510; MB 5230.

Clematis virginiana L. Woodland edge and old field; uncommon; HS 952.

Hydrastis canadensis L. Mesic woods; uncommon; HS 614; MB 6030.

Myosurus minimus L. Cultivated fields and roadsides; common; HS 615.

Ranunculus abortivus L. Fields and roadsides; occasional; HS 594; MB 5750.

Ranunculus pusillus Poiret Bottomland forests and lake edges; occasional; MB 5157 and 5228.

Ranunculus recurvatus Poiret Mesic woods; occasional; MB 5151.

Ranunculus sardous Crantz Fields; common; MB 5144.

Ranunculus sceleratus L. Marshes, fields, and lake edges; uncommon; MB 5030

Ranunculus septentrionalis Poiret Bottomland forests; common; HS 595.

Berberidaceae

Podophyllum peltatum L. Mesic woods; common; HS 684.

Menispermaceae

Cocculus carolinus (L.) DC. Woodland edges and railroad right-of-ways; uncommon; HS 915; MB 7641.

Menispermum canadense L. Woodland edges and bottomland forests; common; HS 330; MB 5330.

Magnoliaceae

Liriodendron tulipifera L. Mesic woods and woodland margins; common; HS 209.

Magnolia acuminata L. Mesic woods; uncommon; HS 450.

Annonaceae

Asimina triloba (L.) Dunal Mesic and bottomland woods; abundant; HS 649; MB 6085.

Lauraceae

Lindera benzoin (L.) Blume Mesic woods; common; MB 5430.

Lindera benzoin (L.) Blume var. *pubescens* (Palmer & Steyermark) Rehder Mesic and bottomland woods; common; HS 262; MB 5331.

Sassafras albidum (Nuttall) Nees Mesic and bottomland woods, railroad right-of-ways, and woodland margins; abundant; HS 205A.

Papaveraceae

Corydalis flavula (Raf.) DC. Mesic woods; common; HS 584.

Dicentra cucullaria (L.) Bernh. Mesic woods; uncommon; HS 579.

Sanguinaria canadensis L. Mesic woods; uncommon; HS 581.

Brassicaceae

Arabidopsis thaliana (L.) Heynh. Fields and woodland edges; common; HS 599.

Armoracia aquatica (Eaton) Wiegand Shallow water of a marsh and swamp edge; uncommon; MB 5219.

Barbarea vulgaris R. Brown Fields and roadsides; uncommon; HS 624.

Brassica rapa L. Fields and roadsides; abundant. Not collected by MB in 1993 survey.

Capsella bursa-pastoris (L.) Medicus Fields and roadsides; abundant; HS 585.

Cardamine bulbosa (Schreber) BSP. Mesic and bottomland woods; uncommon; HS 590; MB 5317.

Cardamine hirsuta L. Mowed lawns, fields, and roadsides; common; HS 596.

Cardamine parviflora L. var. *arenicola* (Britton) O.E. Schultz Mesic woods; rare; MB 5156.

Dentaria lacinata Muhl. Mesic woods; uncommon; HS 580; MB 5025.

Descurainia pinnata (Walter) Britton ssp. *brachycarpa* (Richards.) Detling Roadsides; uncommon; MB 5022.

Draba brachycarpa Nuttall Fields, roadsides, and wet ditches; uncommon; HS 577.

Iodanthus pinnatifidus (Michaux) Steudel Mesic and bottomland woods; uncommon; HS 683; MB 5422.

Lepidium virginicum L. Fields and roadsides; common; HS 435.

Rorippa islandica (Oeder) Borbas Marshes, roadsides, and wet ditches; common; HS 693; MB 5145.

Rorippa islandica (Oeder) Borbas var. *fernaldiana* Butt. & Abbe. Marshes; common; MB 5304.

Rorippa sessiliflora (Nuttall) Hitchcock Marshes and dry ditches; uncommon; HS 528.

Rorippa sylvestris (L.) Bess. Lake edges and wet ditches; common; MB 5164.

Sibara virginica (L.) Rollins Fields; common; HS 578; MB 5010.

Thlaspi arvense L. Fields and roadside ditches; common; HS 606.

Hydrangeaceae

Hydrangea arborescens L. Mesic woods and railroad right-of-ways; uncommon; HS 58.

Escalloniaceae

Itea virginica L. Bottomland woods and swamps; common; HS 571; MB 5256.

Saxifragaceae

Penthorum sedoides L. Fields, marshes, wet ditches, and wooded shorelines; common; HS 924.

Hamamelidaceae

Liquidambar styraciflua L. Mesic and bottomland woods; abundant; HS 82.

Platanaceae

Platanus occidentalis L. Mesic and bottomland woods; common; HS 537; MB 5303.

Rosaceae

Agrimonia rostellata Wallroth Mesic woods and woodland edges; uncommon; HS 873.

Crataegus mollis (Torrey & Gray) Scheele Woodland strip near a dump site and railroad right-of-way; uncommon; HS 955; MB 5329 and 6035.

Crataegus pruinosa (Wendl.) K. Koch Bottomland forest; rare; MB 5420.

Crataegus spathulata Michaux Bottomland forest and woodland edge; uncommon; MB 5234 and 5264.

Crataegus viridis L. Bottomland forests; common; HS 973; MB 5266.

Duchesnea indica (Andr.) Focke. Wet soil along lake margins; common; MB 5011.

Geum canadense Jacquin Mesic woods; common; HS 16; MB 5726.

Geum vernum (Raf.) Torrey & Gray Mesic woods and old roads in mesic woods; uncommon; HS 657.

Malus ioensis (Wood) Britton Mesic and bottomland woods; uncommon; MB 5231 and 5365.

Potentilla norvegica L. Fields; common; HS 740; MB 5423.

Potentilla recta L. Roadsides and railroad right-of-way; uncommon; HS 840; MB 5369.

Prunus persica L. Dump site at field edge; uncommon; MB 6034.

Prunus serotina Ehrhart Disturbed woodland strips and woodland edges; common; HS 652.

Rosa multiflora Thunberg Edges of fields; common; HS 909.

Rosa palustris Marshall Wooded shorelines, swamps, and lake edges; common; HS 828; MB 5725.

Rosa setigera Michaux Woodland edges; uncommon; MB 5421.

Rubus allegheniensis Porter Open woods, old fields, and mesic woods; common; HS 694.

Rubus flagellaris Willd. Lake edge; uncommon; MB 5031.

Rubus laciniatus Willd. Woodland edge; rare; HS 938. Not seen by MB in 1993 survey.

Rubus trivialis Michaux Shoreline thickets, roadsides, ditches, and railroad right-of-ways; common; HS 877; MB 5163 and 5730.

Mimosaceae

Albizzia julibrissin Durazzini Railroad right-of-way and roadsides; common; HS 888; MB 5736.

Desmanthus illinoensis (Michaux) MacM. Roadsides and railroad right-of-ways; common; HS 871; MB 6091.

Caesalpiniaceae

Cassia fasciculata Michaux Fields, roadsides, and railroad right-of-ways; uncommon; HS 874.

Cassia marilandica L. Woodland edges; uncommon; HS 457.

Cassia nictitans L. Fields, roadsides, and open shorelines; common; HS 303.

Cercis canadensis L. Mesic woods and woodland edges; common; HS 610.

Gleditsia aquatica Marshall Swamps and wooded shorelines; uncommon; HS 849; MB 6094.

Gleditsia triacanthos L. Bottomland forests and wooded shorelines; common; HS 48; MB 6096.

Gymnocladus dioicus (L.) K. Koch Mesic and bottomland woods and wooded shorelines; uncommon; HS 447.

Fabaceae

Amphicarpa bracteata (L.) Fernald Mesic woods; uncommon; HS 838.

Apios americana Medicus Wooded shorelines and bottomland forests; uncommon; HS 883.

Desmodium canescens (L.) DC. Woodland edges and roadsides; uncommon; HS 944.

Desmodium glabellum (Michaux) DC. Railroad right-of-ways; uncommon; MB 7632.

Desmodium obtusum (Muhl.) DC. Railroad right-of-way; uncommon; HS 971. Not seen by MB in 1993 survey.

Desmodium paniculatum (L.) DC. Woodland edges, edge of a wooded shoreline, and railroad right-of-ways; uncommon; HS 302; MB 7626.

Galactia regularis (L.) BSP. Railroad right-of-way; uncommon; MB 6099.

Glycine max (L.) Merr. Marsh edge to a cultivated field; uncommon; MB 6041.

Kummerowia stipulacea (Maxim.) Makino Roadsides and mowed areas; common; HS 936.

Kummerowia striata (Thunberg) Schindl. Roadsides and mowed areas; common; HS 451.

Lathyrus hirsutus L. Fields and roadsides; common; MB 5210 and 5215.

Lespedeza cuneata (Dum.-Cours.) G. Don Roadsides and woodland margins; uncommon; HS 466.

Medicago lupulina L. Roadsides; common; HS 876; MB 5899.

Medicago sativa L. Roadsides; uncommon; MB 6090.

Melilotus alba Medicus Roadsides and railroad right-of-ways; common; HS 45; MB 5735.

Melilotus officinalis (L.) Pallas Roadsides and railroad right-of-ways; common; HS 762; MB 5757.

Robinia pseudoacacia L. Wooded shorelines and margins; uncommon; HS 725.

Sesbania macrocarpa Muhl. Marshes, open shorelines, and wet roadside ditches; uncommon; HS 923; MB 4125.

Trifolium campestre Schreber Roadsides; common; HS 708; MB 5902.

Trifolium dubium Sibth. Roadsides; uncommon; HS 625. Not seen by MB in 1993 survey.

Trifolium hybridum L. Fields and roadsides; common; MB 5213.

Trifolium pratense L. Roadsides; common; MB 5324.

Trifolium pratense L. forma *leucochraceum* Aschers. & Prantl Roadside; rare; HS 957.

Trifolium repens L. Roadsides and other mowed areas; common; HS 707.

Vicia cracca L. Fields and roadsides; common; MB 5016 and 5281 (white form).

Vicia sativa L. ssp. *nigra* (L.) Ehrn. Roadsides; common; MB 5008.

Vicia villosa Roth Fields and roadsides; common; HS 728; MB 5023.

Wisteria frutescens (L.) Poiret Bottomland forests; uncommon; HS 505.

Oxalidaceae

Oxalis dillenii Jacquin Woodland edges; uncommon; HS 371.

Oxalis stricta L. Cultivated fields, mesic and bottomland woods, and open shorelines; common; HS 34.

Geraniaceae

Geranium carolinianum L. Fields and roadsides; common; HS 670.

Geranium maculatum L. Mesic woods; uncommon; HS 647.

Euphorbiaceae

Acalypha gracilens Gray Wooded shorelines; uncommon; HS 429.

Acalypha ostryaefolia Riddell Woodland edges, disturbed areas at spillway, and railroad right-of-ways; common; HS 892; MB 3860.

Acalypha rhomboidea Raf. Open shorelines and woodland edges; common; HS 498.

Acalypha virginica L. Woodland edges; uncommon; HS 196.

Chamaesyce maculata (L.) Small Fields, roadsides, and other disturbed areas; common; HS 465; MB 7636.

Chamaesyce supina (Raf.) Moldenke Fields, roadsides, and other disturbed areas; common; HS 929.

Croton glandulosus L. var. *septentrionalis* Muell.-Arg. Fields and railroad right-of-ways; uncommon; HS 870.

Croton monanthogynus Michaux Railroad right-of-ways; uncommon; MB 7633.

Poinsettia dentata (Michaux) Kl. & Garcke. Roadsides and wooded shorelines; common; HS 949; MB 5439.

Callitrichaceae

Callitriche heterophylla Pursh Shallow water of swamps and open lakes; uncommon; HS 608.

Callitriche terrestris Raf. Fields and moist soil; common; MB 5004.

Anacardiaceae

Rhus glabra L. Woodland edges and railroad right-of-ways; common; HS 798; MB 5756.

Toxicodendron radicans (L.) Kuntze Mesic and bottomland woods, railroad right-of-ways, woodland edges, and disturbed areas; abundant; HS 718.

Aquifoliaceae

Ilex decidua Walter Mesic and bottomland forests and woodland edges; common; HS 173; MB 5427.

Celastraceae

Celastrus scandens L. Woodland edges and wooded shorelines; uncommon; HS 488; MB 5341.

Euonymus atropurpureus Jacquin Woodland edges and railroad right-of-ways; uncommon; HS 442; MB 5259.

Euonymus fortunei (Turcz.) Hand.-Maz. Disturbed mesic woods; uncommon; MB 5350.

Aceraceae

Acer negundo L. Mesic and bottomland woods; common; HS 463; MB 5334.

Acer rubrum L. Mesic and bottomland woods; common; HS 42.

Acer rubrum L. var. *drummondii* (H. & A.) Sargent Swamps and bottomland woods; common; HS 530; MB 5438.

Acer saccharinum L. Bottomland woods and shorelines; common; HS 311.

Acer saccharum Marshall Mesic woods; common; HS 285.

Hippocastanaceae

Aesculus pavia L. Mesic and bottomland woods and wooded shorelines; common; HS 645; MB 5006 and 6086.

Balsaminaceae

Impatiens capensis Meerb. Mesic and bottomland woods, logs in swamps, and wooded shorelines; common; HS 91.

Vitaceae

Ampelopsis arborea (L.) Koehne Woodland edge; rare; MB 5398.

Ampelopsis cordata Michaux Woodland edges; common; HS 756; MB 5399.

Parthenocissus quinquefolia (L.) Planchon Wooded shorelines, railroad right-of-ways, woodland edges, and disturbed areas; common; HS 111; MB 5746.

Vitis cinerea Engelm. Mesic and bottomland woods and woodland edges; common; HS 190.

Vitis palmata Vahl Bottomland woods and wooded shorelines; uncommon; HS 231.

Vitis vulpina L. Woodland edges; common; HS 680.

Tiliaceae

Tilia americana L. Mesic woods; uncommon; HS 900.

Malvaceae

Abutilon theophrastii Medicus Fields and edges of marshes; uncommon. Not collected by MB in 1993 survey.

Anoda cristata (L.) Schlecht. Fields; uncommon; MB 6731.

Hibiscus laevis All. Shorelines and swamps; uncommon; HS 225.

Hibiscus lasiocarpus Cav. Marshes, shorelines, and wet ditches; common; HS 39.

Sida spinosa L. Roadsides, woodland edges, and disturbed areas; common; HS 197; MB 6728.

Hypericaceae

Hypericum mutilum L. Fields, marshes, and shorelines; common, HS 824.

Hypericum punctatum Lam. Roadsides, woodland edges, and wooded shorelines; uncommon; HS 829.

Triadenum walteri (Gmelin) Gleason Bottomland forests and logs in swamps, uncommon; HS 308.

Violaceae

Viola missouriensis Greene Bottomland woods and wooded shorelines; common; HS 622, MB 5361.

Viola pratincola Greene Mesic woods; uncommon; HS 582.

Viola pubescens Aiton var. *eriocarpa* (Schweinitz) Russell Mesic woods; common; HS 589; MB 5748.

Viola rafinesquii Greene Fields and roadsides; uncommon; HS 588.

Viola sororia Willd. Mesic woods; common; HS 618; MB 5747.

Viola striata Aiton Mesic woods and woodland edges; uncommon; HS 646.

Viola triloba Schweinitz Mesic woods; uncommon; MB 5342.

Passifloraceae

Passiflora incarnata L. Wooded shorelines; uncommon; HS 83. Not seen by MB in 1993 survey.

Passiflora lutea L. var. *glabriflora* Fernald Mesic woods and woodland edges; uncommon; HS 49.

Lythraceae

Ammannia coccinea Rottb. Marshes, fields, and shorelines; common; HS 159; MB 5410.

Rotala ramosior (L.) Koehne Marshes, fields, and shorelines; common; HS 182; MB 6038.

Nyssaceae

Nyssa aquatica L. Swamps; common; HS 64; MB 5353.

Nyssa sylvatica Marshall Mesic and bottomland woods; common; HS 477; MB 5313.

Onagraceae

Circaea lutetiana Aschers. & Magnus ssp. *canadensis* (L.) Aschers. & Magnus Mesic woods; uncommon; HS 721.

Ludwigia alternifolia L. Woodland margins and an old field; uncommon; HS 919; MB 6025.

Ludwigia decurrens Walter Open shorelines; uncommon; HS 256. Not seen by MB in 1993 survey.

Ludwigia leptocarpa (Nuttall) Hara Open shorelines; uncommon; HS 319; MB 3356.

Ludwigia palustris (L.) Elliott var. *americana* (DC.) Fernald & Griscom Marshes, fields, and open shorelines; common; HS 228; MB 5896.

Ludwigia peploides (HBK.) Raven ssp. *glabrescens* (Kuntze) Raven Open shorelines, marshes, wet ditches, and shallow water of swamps; abundant; HS 181; MB 5893.

Oenothera biennis L. Fields, woodland edges, and roadsides; common; HS 458.

Oenothera laciniata Hill Fields; abundant; HS 675A; MB 5310.

Oenothera pilosella Raf. Open shorelines and woodland edges; uncommon; HS 167; MB 5428.

Oenothera speciosa Nuttall Roadside; uncommon; MB 5229.

Araliaceae

Aralia spinosa L. Mesic woods; uncommon; HS 284.

Apiaceae

Chaerophyllum procumbens (L.) Crantz Roadsides, fields, and mesic woods; common; HS 627; MB 5020.

Chaerophyllum tainturieri Hooker Roadsides; uncommon; MB 5017.

Cicuta maculata L. Mesic and bottomland woods and wooded shorelines; common; HS 548.

Conium maculatum L. Roadsides; uncommon; MB 5432.

Cryptotaenia canadensis (L.) DC. Mesic woods; common; HS 59; MB 5408.

Daucus carota L. Fields and roadsides; common; HS 731.

Eryngium prostratum Nuttall Edge of a marsh; uncommon, although locally common; MB 5739.

Osmorhiza longistylis (Torrey) DC. Mesic woods; uncommon; HS 651.

Ptilimnium costatum (Elliott) Raf. Bottomland woods and woodland margins; common; MB 6009.

Sanicula canadensis L. Mesic and bottomland woods; common; HS 750; MB 5343.

Sium suave Walter Shallow swamps, wet ditches, and open shorelines; common; HS 183.

Torilis japonica (Houtt.) DC. Fields and roadsides; common; HS 739; MB 5717.

Cornaceae

Cornus drummondii C.A. Meyer Woodland edges; common; HS 172; MB 5261 and 5280.

Cornus florida L. Mesic woods; uncommon; HS 278.

Cornus foemina Miller Swamps and bottomland woods; common; HS 470; MB 5254.

Pyrolaceae

Monotropa uniflora L. Mesic woods; rare; HS 549. Not seen by MB in 1993 survey.

Primulaceae

Anagallis arvensis L. Fields; uncommon; HS 784; MB 5161.

Anagallis minima (L.) Krause Marshes; uncommon; MB 5165.

Lysimachia lanceolata Walter Mesic and bottomland woods; uncommon; MB 5407 and 5431.

Lysimachia nummularia L. Bottomland woods, wet ditches, and field margins; uncommon; MB 5253.

Samolus valerandii L. Mesic woods; uncommon; MB 5150.

Ebenaceae

Diospyros virginiana L. Mesic and bottomland woods, woodland edges, and disturbed areas; abundant; HS 146.

Styracaceae

Styrax americana Lam. Bottomland woods and swamps; uncommon; MB 5239.

Oleaceae

Forestiera acuminata (Michaux) Poiret Bottomland woods and woodland edges; uncommon; HS 237; MB 5307.

Fraxinus americana L. Mesic woods; uncommon; HS 796; MB 5357.

Fraxinus pennsylvanica Marshall Mesic and bottomland woods; common; HS 142 and 226; MB 5311.

Fraxinus profunda (Bush) Bush Bottomland woods and swamps; common; HS 114; MB 5345.

Ligustrum vulgare L. Wooded shoreline; uncommon; HS 943. Not seen by MB in 1993 survey.

Loganiaceae

Polypremum procumbens L. Old field; rare; HS 920. Not seen by MB in 1993 survey.

Spigelia marilandica L. Bottomland woods; rare; MB 6010.

Apocynaceae

Amsonia tabernaemontana Walter Wooded shorelines, wet ditches, and bottomland woods; uncommon; HS 508; MB 5028.

Apocynum cannabinum L. Field and woodland edges and roadsides; common; HS 732.

Trachelospermum difforme (Walter) Gray Bottomland woods; uncommon. Not collected by MB in 1993 survey.

Asclepiadaceae

Asclepias incarnata L. Open shorelines; uncommon; HS 942.

Asclepias perennis Walter Bottomland woods; common; HS 760; MB 5728 and 6024.

Asclepias syriaca L. Roadsides and railroad right-of-ways; common; HS 817; MB 5889.

Cynanchum laeve (Michaux) Persoon Roadsides, woodland edges, and other disturbed areas; common; HS 9.

Matelea gonocarpa (Walter) Shinners Bottomland woods; rare; MB 5751.

Convolvulaceae

Calystegia sepium (L.) R. Brown ssp. *americana* (Sims) Brummitt Roadsides and woodland margins; common; HS 710; MB 5887.

Convolvulus arvensis L. Fields and railroad right-of-ways; uncommon; HS 781.

Ipomoea coccinea L. Roadsides; uncommon; HS 257.

Ipomoea hederacea (L.) Jacquin Fields; common; HS 166.

Ipomoea lacunosa L. Fields and open shorelines; common; HS 177.

Ipomoea pandurata (L.) G.F.W. Mey. Railroad right-of-way; uncommon; MB 6008.

Ipomoea purpurea (L.) Roth Fields and roadsides; common; HS 169.

Cuscutaceae

Cuscuta gronovii Willd. Wooded shorelines on herbaceous and shrubby plants; uncommon, although locally abundant; HS 406.

Polemoniaceae

Phlox divaricata L. ssp. *laphamii* (Wood) Wherry Mesic woods; uncommon; HS 612; MB 5749.

Hydrophyllaceae

Phacelia ranunculacea (Nuttall) Constance Mesic woods; common; HS 600; MB 5014.

Boraginaceae

Buglossoides arvense (L.) I.M. Johnston Roadsides; uncommon; MB 5021.

Cynoglossum virginianum L. Mesic woods; uncommon; MB 5153.

Hackelia virginiana (L.) I.M. Johnston Mesic woods; uncommon; HS 856.

Heliotropum indicum L. Open shorelines; uncommon; HS 107. Not seen by MB in 1993 survey.

Lithospermum latifolium Michaux Mesic woods; uncommon; HS 726; MB 5149.

Myosotis macrosperma Engelm. Fields and mesic woods; common; MB 5018.

Myosotis verna Nuttall Wooded shorelines, fields, and roadsides; common; HS 635; MB 5005.

Verbenaceae

Phyla lanceolata (Michaux) Greene Open shorelines, wet ditches, and disturbed areas; common; HS 11; MB 5892.

Verbena urticifolia L. Woodland edges, roadsides, and disturbed areas; common; HS 482.

Phrymaceae

Phryma leptostachya L. Mesic woods; uncommon; HS 134.

Lamiaceae

Agastache nepetoides (L.) Kuntze Wooded shorelines and mesic woods; uncommon; HS 558.

Blephilia ciliata (L.) Bentham Mesic woods; uncommon; HS 741.

Blephilia hirsuta (Pursh) Bentham Mesic woods; uncommon; HS 754.

Glechoma hederacea L. var. *micrantha* Moricand. Lake edge; uncommon; MB 5226.

Hedeoma pulegioides (L.) Persoon Field edges; uncommon; HS 327. Not seen by MB in 1993 survey.

Lamium amplexicaule L. Fields, roadsides, and other disturbed areas; common; HS 586.

Lamium purpureum L. Fields, roadsides, and other disturbed areas; common; HS 603.

Leonurus cardiaca L. Roadside and woodland margin; uncommon; MB 5352.

Lycopus americanus Muhl. Fields, marshes, wet ditches, and open shorelines; uncommon; HS 922.

Lycopus rubellus Moench Open shorelines and logs in swamps; uncommon; HS 568.

Lycopus virginicus L. Open shorelines; uncommon. Not collected by MB in 1993 survey.

Mentha arvensis L. Open shorelines; uncommon; HS 941. Not seen by MB in 1993 survey.

Perilla frutescens (L.) Britton Fields and disturbed areas; uncommon; HS 386.

Prunella vulgaris L. Woodland edges and disturbed areas; common;
HS 54.

Pycnanthemum tenuifolium Schrader Mesic woods; uncommon; MB 6012.

Scutellaria lateriflora L. Bottomland woods and logs in swamps; common; HS 564.

Scutellaria nervosa Pursh Bottomland woods; common; HS 844; MB 5155.

Scutellaria ovata Hill Mesic woods; uncommon; HS 789; MB 5346.

Stachys tenuifolia Willd. Mesic and bottomland woods; uncommon; HS 904; MB 6020.

Teucrium canadense L. var. *virginicum* (L.) Eaton Woodland edges and bottomland woods; uncommon; HS 797; MB 6023.

Solanaceae

Datura stramonium L. Fields and other disturbed areas; uncommon; HS 473.

Datura stramonium L. var. *tatula* (L.) Torrey Fields and roadsides; uncommon; MB 6097.

Lycopersicum esculentum Mill. Woodland edge; rare. Not collected by MB in 1993 survey.

Physalis angulata L. Roadsides; uncommon; MB 7653.

Physalis heterophylla Nees Woodland edges; uncommon; HS 454. Not seen by MB in 1993 survey.

Physalis ixocarpa Hornem. Edge of a field; uncommon; MB 6732.

Physalis subglabrata Mackenzie & Bush Roadsides and railroad right-of-ways; common; HS 393; MB 5898 and 6220.

Solanum carolinense L. Fields, roadsides, and other disturbed areas; common; HS 730.

Solanum ptycanthum Dunal Roadsides, railroad right-of-ways, and other disturbed areas; common; HS 925; MB 5755.

Scrophulariaceae

Bacopa rotundifolia (Michaux) Wettst. Marshes, open shorelines, and wet ditches; common; HS 156; MB 5416.

Dasistoma macrophylla (Nuttall) Raf. Woodland edges; uncommon; HS 854.

Gratiola neglecta Torrey Fields and marshes; abundant; HS 678; MB 5402.

Leucospora multifida (Michaux) Nuttall; Fields; uncommon; MB 7746.

Linaria texana Scheele Fields and roadsides; uncommon; HS 706; MB 5159.

Lindernia dubia (L.) Pennell Fields and marshes; abundant; HS 157; MB 5745.

Lindernia dubia (L.) Pennell var. *anagallidea* (Michaux) Cooperrider Fields and marshes; abundant; HS 779; MB 6027.

Lindernia dubia (L.) Pennell var. *riparia* (Raf.) Fernald Fields and marshes; uncommon; MB 6028.

Mimulus alatus Aiton Bottomland woods and wet ditches; common; HS 216.

Penstemon alluviorum Pennell Bottomland woods and woodland margins; uncommon; MB 5223 and 5409.

Penstemon digitalis Nuttall Woodland margins and roadsides; uncommon; MB 5250.

Scrophularia marilandica L. Mesic woods; uncommon; HS 260.

Veronica arvensis L. Fields and roadsides; common; HS 598.

Veronica peregrina L. Fields and roadsides; common; HS 630.

Veronica peregrina L. ssp. *xalapensis* (HBK.) Pennell Fields; common; MB 5146.

Bignoniaceae

Campsis radicans (L.) Seem. Fields, woodland edges, and mesic and bottomland woods; abundant; HS 10; MB 5753.

Catalpa speciosa Warder Bottomland woods and woodland edges; common; HS 171.

Acanthaceae

Ruellia strepens L. Mesic and bottomland woods and railroad right-of-way; uncommon; HS 439; MB 5308.

Plantaginaceae

Plantago aristata Michaux Fields, roadsides, and other disturbed areas; common; HS 763; MB 5716.

Plantago lanceolata L. Roadsides and mowed areas; common; HS 879; MB 5900.

Plantago rugelii Dcne. Fields, roadsides, and other disturbed areas; common, HS 744; MB 5901.

Plantago virginica L. Fields, roadsides, and other disturbed areas; common; HS 636.

Rubiaceae

Cephalanthus occidentalis L. Shorelines, wet ditches, bottomland woods, and swamps; abundant; HS 12.

Cephalanthus occidentalis L. var. *pubescens* Raf. Wet ditches, bottomland woods, and swamps; uncommon; MB 5888.

Diodia teres Walter Roadsides and railroad right-of-ways; uncommon; MB 7647.

Diodia virginiana L. Roadsides, open shorelines, and wet ditches; common; HS 106; MB 6567.

Galium aparine L. Woodland edges and mesic woods; common; HS 658.

Galium circaezans Michaux Mesic woods; uncommon; HS 723; MB 5344.

Galium obtusum Bigelow Bottomland woods; common; MB 5358.

Galium tinctorium L. Open shorelines; common; HS 748; MB 6022.

Galium triflorum Michaux Mesic woods; uncommon; HS 118.

Hedyotis crassifolia Raf. Roadsides; uncommon; HS 593. Not seen by MB in 1993 survey.

Caprifoliaceae

Lonicera japonica Thunberg Disturbed areas; common; HS 716.

Lonicera maackii (Rupr.) Maxim. Railroad right-of-way; rare; MB 6219.

Sambucus canadensis L. Woodland edges, roadsides, and mesic woods; common; HS 295; MB 5891.

Symphoricarpos orbiculatus Moench Woodland edges and mesic woods; uncommon. Not collected by MB in 1993 survey.

Viburnum prunifolium L. Woodland edges; uncommon; HS 902. Not seen by MB in 1993 survey.

Viburnum recognitum Fernald Mesic woods; uncommon; MB 5362.

Viburnum rufidulum Raf. Mesic woods; uncommon; MB 5368.

Valerianaceae

Valerianella radiata (L.) Dufr. Fields, roadsides, and open shorelines; common; HS 666.

Cucurbitaceae

Citrullus lanatus (Thunberg) Matsumura & Nakai Woodland edge; rare. Not collected by MB in 1993 survey.

Melothria pendula L. Roadsides and railroad right-of-ways; uncommon; MB 6014 and 7643.

Sicyos angulatus L. Woodland edges and railroad right-of-ways; common; HS 306; MB 7638.

Campanulaceae

Campanula americana L. Mesic woods and woodland edges; uncommon; HS 55; MB 6082.

Lobelia cardinalis L. Bottomland woods and wet ditches; uncommon; HS 215.

Lobelia inflata L. Wooded shorelines, mesic woods, roadsides, and fields; uncommon; HS 931.

Triodanis perfoliata (L.) Nieuwland Fields and woodland edges; common; HS 699.

Triodanis perfoliata (L.) Nieuwland var. *biflora* (R. & P.) Fisch. & Mey. Fields; uncommon; MB 5154.

Asteraceae

Ambrosia artemisiifolia L. Roadsides and field edges; common; HS 414.

Ambrosia trifida L. Field and woodland edges and mesic woods; common; HS 377.

Artemisia annua L. Dump site and along a fence row; rare; HS 969.

Aster drummondii Lindley Woodland edges; abundant; HS 568 and 959; MB 7829.

Aster lateriflorus (L.) Britton Mesic and bottomland woods and woodland edges; common; HS 455.

Aster ontarionis Wiegand Bottomland forests and railroad right-of-ways; common; MB 7628.

Aster pilosus Willd. Woodland edges and disturbed areas; common; HS 415.

Aster praealtus Poiret Open shorelines; uncommon; HS 440. Not seen by MB in 1993 survey.

Aster simplex Willd. Woodland edges; uncommon; HS 523.

Bidens aristosa (Michaux) Britton Fields, roadsides, woodland edges, and other disturbed moist areas; common; HS 480.

Bidens aristosa (Michaux) Britton var. *retrorsa* (Sherff) Wunderlin Open shorelines; uncommon; HS 349.

Bidens cernua L. Open shorelines and logs in swamps; common; HS 485.

Bidens discoidea (Torrey & Gray) Britton Open shorelines and logs in swamps; common; HS 348.

Bidens frondosa L. Wet ditches, bottomland woods, and open shorelines; common; HS 436.

Bidens tripartita L. Marshes, wet ditches, and open shorelines; common; HS 928; MB 6040.

Boltonia asteroides (L.) L'Her. Wet ditches and bottomland woods; uncommon; HS 304.

Carduus nutans L. Railroad right-of-way; uncommon; MB 5305.

Cichorium intybus L. Roadsides and railroad right-of-ways; uncommon; HS 737.

Cirsium discolor (Muhl.) Sprengel Fields and roadsides; uncommon; HS 390.

Cirsium vulgare (Savi) Tenore Roadsides; uncommon; MB 6566.

Conyza canadensis (L.) Cronquist Fields and roadsides; common; HS 318.

Conyza ramosissima Cronquist Roadsides; uncommon; HS 930; MB 6733.

Crepis pulchra L. Roadsides; uncommon; MB 5212 and 5248.

Eclipta prostrata (L.) L. Open shorelines, wet ditches, bottomland woods, and marshes; common; HS 155.

Elephantopus carolinianus Raeusch. Mesic woods; uncommon; HS 210.

Erechtites hieracifolia (L.) Raf. Fields, roadsides, and railroad right-of-ways; common; MB 7634.

Erigeron annuus (L.) Persoon Fields and roadsides; common; HS 291; MB 5425.

Erigeron philadelphicus L. Fields and roadsides; common; HS 674.

Erigeron strigosus Muhl. Fields and roadsides; common; HS 366.

Eupatorium coelestinum L. Woodland edges and old fields; uncommon; HS 912.

Eupatorium incarnatum Walter Bottomland woods and woodland edges; uncommon; HS 533.

Eupatorium rugosum Houtt. Mesic woods and railroad right-of-ways; common; HS 378; MB 7640.

Eupatorium serotinum Michaux Roadsides and open shorelines; uncommon; HS 407.

Galinsoga quadriradiata Ruiz & Pavon Fields and other disturbed areas; uncommon; MB 7761.

Gnaphalium purpureum L. Old field; uncommon; HS 766.

Helenium amarum (Raf.) Rock Roadsides and railroad right-of-ways; common; HS 310; MB 5752.

Helianthus annuus L. Fields; common; MB 6032.

Helianthus rigidus (Cass.) Desf. Woodland edges; rare; HS 905. Not seen by MB in 1993 survey.

Helianthus strumosus L. Woodland edges; uncommon; HS 906.

Helianthus tuberosus L. Woodland edges and railroad right-of-way; uncommon; HS 321.

Heliopsis helianthoides (L.) Sweet Woodland edges; uncommon; MB 6083.

Heterotheca latifolia Buckley Roadsides and railroad right-of-way; rare; HS 812.

Iva annua L. Woodland edges and roadsides; common; HS 244; MB 7655.

Krigia caespitosa (Raf.) Chambers Fields; common; HS 775.

Lactuca canadensis L. Roadsides and railroad right-of-ways; common; HS 891.

Lactuca floridana (L.) Gaertner Woodland edges and railroad right-of-ways; common; HS 383; MB 7639.

Lactuca saligna L. Roadsides; uncommon; HS 230.

Lactuca serriola L. Roadsides; uncommon; HS 890.

Matricaria chamomilla L. Fields; uncommon; MB 5166, 5242, and 5347.

Matricaria matricarioides (Less.) Porter Roadsides; common; HS 519; MB 5158.

Polymnia uvedalia L. Mesic woods; uncommon; HS 277.

Pyrrhopappus carolinianus (Walter) DC. Fields and roadsides; common; HS 365; MB 5312.

Rudbeckia hirta L. Roadsides; uncommon; HS 806; MB 5737.

Rudbeckia laciniata L. Woodland edges and mesic woods; uncommon; HS 474.

Senecio glabellus Poiret Fields and roadsides; common; HS 617.

Solidago canadensis L. Woodland edges and railroad right-of-ways; common; HS 467.

Solidago gigantea Aiton. Woodland edge; uncommon; MB 6565.

Solidago ulmifolia Muhl. Railroad right-of-way; rare; MB 7637.

Sonchus asper (L.) Hill Roadsides; uncommon; MB 5274.

Tagetes patula L. Dump site; rare; MB 6031.

Taraxacum laevigatum (Willd.) DC. Railroad right-of-way; uncommon; MB 5257.

Taraxacum officinale Weber Roadsides; common; HS 309.

Verbesina alternifolia (L.) Britton Mesic woods; uncommon; HS 271.

Vernonia gigantea (Walter) Trelease Roadsides, woodland edges, and old fields; uncommon; HS 275; MB 6563.

Vernonia missurica Raf. Woodland edges; uncommon; HS 188.

Xanthium strumarium L. var. *canadensis* (Miller) Torrey & Gray Fields, roadsides, and other disturbed areas; common; HS 576; MB 7648.

JOB 5: HERPETOFAUNA OF HORSESHOE LAKE CONSERVATION AREA

Ronald A. Brandon

PART ONE

SURVEY

Introduction

Amphibians and reptiles from Horseshoe Lake have been mentioned in the literature since the early 1900s. The area, particularly the forest on the island, has been on the itinerary of field trips from a number of museums and universities over the past 40 years. Of 617 voucher specimens located in a dozen museum and university collections, 3% were collected between 1907 and 1930, 12% in the 1930s, 50% in the 1950s, 26% in the 1960s, and the remaining 9% in the period 1970-1994. The area has been popular with herpetologists because a large portion of the Illinois herpetofaunal diversity occurs there (currently 56%) and because it had an exotic, Austroriparian flavor and large turtle populations. Four amphibians and reptiles listed as threatened or endangered by the State of Illinois have been reported from Horseshoe Lake.

Objective

1. Provide basic information on the diversity and relative abundance of amphibians and reptiles within Horseshoe Lake Conservation Area in 1993-1994.

Methods

Surveys for Breeding Frogs

Three methods were used to locate and identify breeding frogs and their breeding habitats: (1) Driving roads throughout the Conservation Area after dark, mostly during or after rain, listening for and locating calling males - particularly effective during the months February through May; (2) listening for calling male frogs during daylight hours while searching for other species; (3) examining ditches, rain pools, flooded woodlands, and ponds for tadpoles, samples of which subsequently were preserved and identified or reared through metamorphosis in the laboratory to confirm identification - effective during late spring and early summer.

Surveys for Threatened and Endangered Species

Historic localities for endangered and threatened species were identified as closely as possible and examined repeatedly, as were other apparently suitable localities. In addition, museum collections were examined for specimens from the vicinity of Horseshoe Lake.

General Surveys of All Amphibians and Reptiles

Each available habitat type was searched by at least two experienced herpetologists, walking through woodlands, along roads, along shorelines, during the day and after dark, recording observations and number (or approximate number) of animals seen or heard. Superficial cover (rocks, logs, boards, metal, leaf litter, etc.) was lifted and replaced. Animals seen on roads were recorded and road-kills were preserved. Because of the flood, there was no opportunity to install arrays of drift fences. Special efforts were made to search habitats appropriate for rare, threatened, and endangered species known to have occurred in the area. Observations are documented in field notebooks, on 7.5-minute topographic quadrangle maps, sound recordings, 35-mm color slides, 8-mm video recordings, and preserved specimens deposited in the SIUC Herpetology Collection.

Historical Data

Historical data come from three sources: (1) The published literature, (2) previous field work carried out at SIUC, and (3) voucher specimens cataloged in the following museum collections: Carnegie Museum (CM), Chicago Academy of Sciences (CAS), Field Museum of Natural History (FMNH or CMNH), Illinois Natural History Survey (INHS), Museum of Comparative Zoology, Harvard University (MCZ), Museum of Vertebrate Zoology, Berkeley (MVZ), National Museum of Natural History (USNM), Natural History Museum of Los Angeles County (LACM), Southern Illinois University at Carbondale Herpetology Collection (SIUC), University of Illinois Museum of Natural History (UIMNH), University of Kansas Museum of Natural History (KU), University of Michigan Museum of Zoology (UMMZ). Also searched for Horseshoe Lake specimens were the American Museum of Natural History, California Academy of Sciences, Florida Museum of Natural History, Michigan State University Museum, Milwaukee Public Museum, Ohio University Vertebrate Collection, Texas Cooperative Wildlife Collection, and Tulane University.

Results

General

In all, 193 hours (561 person-hours) were spent in the field at Horseshoe Lake Conservation Area (not counting one

hour travel time each way from Carbondale) during 36 days in 1993-1994. In 1993, field work was conducted throughout the area from February 6th until July 15th, when the area was flooded by a break in the levee south of Miller City. Thereafter, field work continued on the periphery of flood waters wherever possible throughout the remainder of summer and during autumn until the last of October. In 1994, field work resumed on February 13th and continued until April 16th, although it was constrained again by flood waters after April 5th.

Person-hours devoted per month reflect relative emphasis on detecting spring-breeding frogs, summer activity of reptiles, and autumnal activity of reptiles and young-of-the-year amphibians: February (58), March (110.5), April (66), May (18), June (78.5), July (89), August (32), September (61), October (48). Field work was carried out between the hours of 0800 and 0100, 20% of the time noon or earlier, 42% of the time between noon and 1800 hr, and 38% of the time after 1800 hr.

Results of Field Surveys

Results of our herpetofaunal surveys are summarized in Table 5-1, Figures 5-1 through 5-19, and in the following species accounts that summarize estimates of relative abundance, habitat preferences, and life history information. Common and zoological names, unless indicated otherwise, are from Collins (1990). In all, 37 species of amphibians and reptiles were observed in the Horseshoe Lake area; this amounts to 36% of the total herpetofaunal diversity of Illinois (102 species) and 65% of the species previously known from the area. Twenty species (2 frogs, 2 salamanders, 1 lizard, 5 turtles, and 10 snakes) previously reported from the area were not observed during this survey: bird-voiced treefrog, pickerel frog, central newt, longtail salamander, fence lizard, river cooter, false map turtle, common map turtle, smooth softshell, spiny softshell, ringneck snake, eastern hognose snake, red milk snake, Mississippi green water snake, broad-banded water snake, copperhead, cottonmouth, mud snake, northern water snake, and eastern earth snake.

Species Accounts

Cricket Frog, Acris crepitans. This small shoreline frog is widespread and abundant along the edge of Horseshoe Lake and practically every other body of water in the area (Figure 5-1), as it was during a 1987 survey (Brandon and Morris, 1987). In 1993-1994 adults were seen between 22 February and 21 October. Choruses of the cricket-like breeding calls were heard between 28 April and 22 July, and hundreds of newly

transformed juveniles had begun to enter the population by 22 June.

American Toad, Bufo americanus. Although most toads encountered were Fowler's toads, the American toad was seen frequently south of Miller City and at a few other scattered localities (Figure 5-1). Additional sites were noted along lower Lake Creek in 1987, at places inaccessible during 1993-1994. Choruses were heard 5 and 9 April and many adults were seen on roads. Recently transformed young appeared by early June. A few individuals were found in woodlands 12 August and 17 September.

Fowler's Toad, Bufo woodhousii. These toads are widespread and abundant and were noted on practically every visit to the area (Figure 5-2). Adults were seen on roads during rain on 22 March. Breeding calls were heard 28 April through 24 June; a female was observed spawning on 28 April. Tadpoles and transforming juveniles were observed 6 June; thereafter (22 June into October) hundreds of growing young-of-the-year juveniles were observed along with subadults and adults, particularly on and along roads in rain.

Cope's Gray Treefrog, Hyla chrysoscelis. Of the two species of gray treefrog in eastern United States, only Hyla chrysoscelis was heard calling in the Conservation Area and the many museum specimens from the 1940s and 1950s probably are of this species. The morphologically similar Hyla versicolor occurs sympatrically with Cope's gray treefrog in Monroe and Randolph counties, but its fairly distinctively different call was not heard at Horseshoe Lake. Therefore, juveniles and adults found on roads are all recorded as H. chrysoscelis (Figure 5-2). Gray treefrogs were seen or heard commonly throughout the area. The breeding season is relatively long. Mating calls were heard from 30 March until late July, with greatest intensity during late May and early June. Tadpoles were seen from 28 April through June. Recently transformed juveniles were first seen on 11 June, and thereafter until early August.

Green Treefrog, Hyla cinerea. These Austroriparian frogs are abundant in emergent vegetation all along the lake's edge and in adjacent ponds (Figure 5-3). Yearling juveniles were found on roads in rain as early as 28 April and adults as late as 19 October. Breeding calls of this summer-breeding frog were heard from 11 June to 12 August, with the largest choruses in June and July. Recently transformed juveniles were first observed on 10 August, and growing juveniles were seen throughout the autumn. There are museum specimens from the 1940s and 1950s, and Brandon and Morris (1987) found it to be common. In 1961, Smith reported green treefrogs only from the Horseshoe Lake area and the Pine Hills/Wolf Lake area of Union County. These frogs are now documented from

Jackson County, the Cache River valley counties, and southern Pope County. Its range may be expanding currently.

Spring Peeper, Pseudacris crucifer. This frog seems to occur in every wooded wetland in the Horseshoe Lake area (Figure 5-3), where the number of spring breeding choruses indicate it is abundant, even though the arboreal adults are seldom seen outside of the breeding season. Males were heard calling, a few at a time or in large choruses, from 22 February through April, often along with P. feriarum and P. streckeri. A few called in light rain on 19 October as others were seen crossing a road. There are a few museum specimens from the 1940s and 1950s.

Upland Chorus Frog, Pseudacris feriarum. This lowland forest frog is common and distributed widely throughout the area (Figure 5-4), but is seldom seen outside the spring breeding season. It often chorused sympatrically with the more upland spring peeper in temporary pools and ditches. Breeding choruses were heard from 14 February through mid April. A young-of-the-year juvenile was found in grass on 15 July. Smith (1961) shows this species at Horseshoe Lake and there are museum specimens from the 1940s, 1950s, and 1960s, all listed as Pseudacris triseriata feriarum. Hedges (1986) presented evidence that P. feriarum is a separate species.

Illinois Chorus Frog, Pseudacris streckeri. This state-threatened species is widely distributed in the sandy soils of the Horseshoe Lake area (Figure 5-4) where it reproduces in pools and ditches in cultivated fields, and along edges of woods and roads. Calling males were noted from a dozen sites within the Conservation Area, 3 sites as far south toward Dogtooth Bend as Willard, 14 sites to the west between the Conservation Area and the Mississippi River, and nearly 20 sites north of the Conservation Area as far as Sandusky. Males were heard calling, usually only a few (2-5) at a time, on 13 dates from 10 February through 9 April. The number of calling males heard at any one time probably is an underestimate of population size. At one pond where only 4 males had been calling a week earlier, we found 38 egg masses. Many of the plotted localities are based on breeding calls heard in the vicinity. Some individuals were found on roads during or following rain (26 March, 10 April, 14 July). Verified breeding sites and places where animals were seen on roads are indicated in Figure 5-20.

Plains Leopard Frog, Rana blairi. This frog, although not common, was encountered in small numbers throughout the Conservation Area (Figure 5-5). Individuals were seen on 26 March, 10 April, 24 June, and 14-15 July, most of them on roads. Dr. Edward Moll showed us a breeding pond in the middle of the island, and an adult was found in a water-filled roadside drainage ditch west of the Conservation Area.

According to Brown and Morris (1990), this frog never gets far from water, and has been found along creeks, in old fields, and in disturbed but non-agricultural lands. This is a species of the Great Plains and the Prairie Peninsula of Illinois, with populations extending southward along the Mississippi River valley through Horseshoe Lake and into Southeastern Missouri (Brown and Morris, 1990; Brown et al., 1993). It is not possible to judge previous abundance at Horseshoe Lake because older specimens would have been identified as R. sphenocephala or R. pipiens.

Bullfrog, Rana catesbeiana. Bullfrogs occur in abundance throughout the Conservation Area (Figure 5-5), as it is throughout most of Illinois. Juveniles and, occasionally, adults were observed on roads in rain from 22 March through 19 October. Calling males were heard from 6 June through 11 August.

Green Frog, Rana clamitans. This frog, mainly a clear stream resident, was observed only occasionally at the northwest corner of the Conservation Area, at or just north of the mouth of Black Creek (Figure 5-6). It undoubtedly is more common in springs and streams of the hills to the northwest. There is a museum specimen (UIMNH 43653) from Horseshoe Lake, but Smith (1961) did not show the species there. Brandon and Morris (1987) found this frog at the spillway and at the mouth of Lake Creek.

Southern Leopard Frog, Rana sphenocephala. This is the ubiquitous frog in this part of southern Illinois, and it is abundant and widespread in the Conservation Area (Figure 5-6). Breeding choruses were heard in late March and tadpoles collected from 28 April into mid July. The first transformed young-of-the-year were seen on 6 June and hundreds were encountered from late July through October. Adults were common along the shores of the lake, ponds, and sloughs, and were found in damp grassy fields at some distance from the shore. Museum specimens collected in the 1950s are identified as Rana pipiens, but the southern leopard frog is now considered a separate species from the northern leopard frog (Mecham et al., 1973) and its proper name is Rana sphenocephala, not R. utricularia (International Commission on Zoological Nomenclature, 1992). Many museum specimens were collected in the 1930s, 1940s, 1950s and 1970s, and Brandon and Morris (1987, 1988) found it to be abundant.

Eastern Spadefoot, Scaphiopus holbrookii. These rarely seen anurans seem to be relatively widespread in the Conservation Area (Figure 5-7). Because of their burrowing habits they probably are more abundant than encounters with them would suggest. Five adults were observed at a breeding pond near the spillway where a chorus was underway on 9 April. Chorusing was heard at another breeding pond north of

the Conservation Area on the same night, and two adults were found on a nearby road. An adult was found dead in the woods on the island on 23 April, and another was found on a road in rain on 11 June. Small tadpoles were taken from a small woodland pool on the south end of the island, and recently transformed juveniles were found near a patch of woods in the center of the island on 22 June. A series of museum specimens was collected at Horseshoe Lake in the 1950s.

Spotted Salamander, Ambystoma maculatum. About a dozen of these distinctly marked, forest-dwelling salamanders were found at 5 localities (map 5-7) between 22 March and 22 July, along a wet gravel road, in rotting logs, under a rock, or crossing roads on rainy nights (Figure 5-7). A large population apparently occurs in the forested alluvial and glacial outwash soils (Robertson et al., 1978) nature preserve at the southern end of the island where individuals were seen in 1987 and had been collected commonly in the 1950s and 1960s (museum vouchers). As recently as 1989 (Parmelee, 1993) the spotted salamander remained common on the island. None was seen on 23 April or 22 June 1993 and further searching during this survey was prevented by floodwaters. The effect of flood waters on this and other species of burrowing salamander on the island should be examined in the near future.

Marbled Salamander, Ambystoma opacum. Only one specimen of this autumn-breeding species was found, an adult under a piece of metal (Figure 5-8) on 16 April. Again, none was found on the island on 23 April or 22 June and further searches were prevented by the floods. This species has been collected at Horseshoe Lake since at least 1924, and many museum specimens were collected on the forested southern end of the island in the 1950s. Parmelee (1993) found marbled salamanders about half as frequently as spotted salamanders in 1989. Because of its reproductive habits, the floods of 1993-1994 may have had a severely negatively impact on recruitment of new generations. These salamanders breed and lay eggs in terrestrial settings, in basins that will become inundated by autumn rains. The larvae hatch into these temporary waters, grow throughout winter and transform by mid-summer. Since the floods may have stocked most of the normally intermittent island basins with fish, mortality on larval salamanders would be high, perhaps complete. Salamander larvae commonly are extirpated from ponds once they have been stocked with fish (Brandon and Bremer, 1966). Flood waters carrying fish into Ambystoma ponds on the island (and elsewhere) could have destroyed a year class of juveniles.

Mole Salamander, Ambystoma talpoideum. Five individuals, 3 adults, 1 subadult, and 1 recently transformed, were found at two localities on 14 July, 22 July, and 10 August (Figure

5-8). The subadult was in a shallow burrow under an old railroad tie, the others on a road. During the 1950s this species was common on the island (museum records) and Parmelee (1993) found it in about the same numbers as A. opacum in 1989.

Smallmouth Salamander, Ambystoma texanum. This burrowing lowland salamander is widespread and abundant throughout southern Illinois and in the Horseshoe Lake area (Figure 5-9). Brandon and Morris (1987) found it on the Island and many museum specimens came from there in the 1950s and 1960s. Parmelee (1993) encountered it 11 times more frequently than A. maculatum, and 5 times more frequently than A. opacum and A. talpoideum. Egg clusters were observed in morula stage 6 February and many larvae were seen April 28 and 11 May. More than 40 transformed young-of-the-year were observed on 10, and 22 July under logs and debris on damp soil. Adults were seen on roads and in rotting logs on 5 and 28 April, 24 June, and 14 and 22 July. One live adult, one dead adult, and 16 young-of-the-year were observed swimming across a flooded road during the day of 22 July.

Slimy Salamander, Plethodon glutinosus. This terrestrial, woodland salamander was found only on the island, under logs on the most elevated land (Figure 5-9). Several individuals were observed on 11 May and 23 April. This salamander has been known from the Horseshoe Lake island since the 1950s. Brandon collected some there in 1960. Because this species lives in burrows in well drained soil under logs, rocks, and other plant debris, where females deposit and brood direct-developing eggs (no larval stage) this species would not be as tolerant of high ground water and floods as the species of Ambystoma would be.

Lesser Siren, Siren intermedia. Concentrated collecting effort probably would show this aquatic, burrowing salamander to be common throughout waters of the Horseshoe Lake area, as it is in much of southern Illinois (Smith, 1961). We found one animal at both of two places where we tried to find it (Figure 5-10).

Snapping Turtle, Chelydra serpentina. Although the highly aquatic and largely predatory common snapping turtle was recorded from only three scattered localities (Figure 5-10), on 22 February, 23 April, and 23 October, directed sampling probably would reveal it to be common throughout the lake and streams leading into and out of it. Cahn (1937) reported the species from Horseshoe Lake. A skeleton was found at the spillway in 1987.

Painted Turtle, Chrysemys picta. This aquatic, omnivorous turtle seems to be common and generally distributed throughout the Conservation Area (Figure 5-11)

where individuals were observed basking 28 April, 11 May, 6, 22, and 29 June, and 30 September. A few eggs from a clutch found 11 June were identified from hatchlings in the laboratory. Individuals were found on roads 28 April and 30 September. The population here apparently always has been large. A large series collected by M. B. Troutman, in 1936, is in the University of Michigan Museum of Zoology, and Cahn (1937) reported it from Horseshoe Lake. Other museum specimens were taken in the 1950s. Brandon and Morris (1987) found it to be abundant and widespread.

Common Musk Turtle, Sternotherus odoratus. This lowland aquatic turtle seems to be generally distributed in and around Horseshoe Lake (Figure 5-11), and probably is abundant. Activity is mainly crepuscular and they walk about the soft bottoms of lakes, ponds, sloughs, and slow streams searching for food (fish and a variety of invertebrates). These turtles bask with most of the body under water and they seldom leave water except to lay eggs and occasionally to move overland (Ernst and Barbour, 1972). We found individuals on roads 16 and 17 April, 14 July, 12 August, and 17 September and one was seen in water on 30 September. Four eggs were found 29 June under a rotting log at the spillway. Two yearlings were found the same day in pickerel weed along the shore just above the spillway. Horseshoe Lake musk turtles collected in the 1930s, 1940s, and 1950s are in museum collections.

Eastern Box Turtle, Terrapene carolina. This omnivorous, terrestrial woodland turtle is common in southern Illinois (Smith, 1961) and seems to occur throughout the woodlands of the Conservation Area (Figure 5-12). Individuals were encountered from 23 April through August, at the lake shore, in forest floor litter, and in the depression of a dried pond. One skeleton was found on 12 August. These animals commonly seek underground shelter from summer heat and have been observed burrowing into mud or entering water. They hibernate underground, in burrows, plant debris, mud-bottomed pools, sometimes under water (Ernst and Barbour, 1972). They can escape flood waters by swimming.

Red-eared Slider, Trachemys scripta. This largely carnivorous species is by far the most common aquatic turtle in the Horseshoe Lake area (Figure 5-12), as well as elsewhere in the heavily vegetated, soft-bottomed streams, lakes, sloughs and ponds of southern Illinois (Cahn, 1937; Smith, 1961). Brandon and Morris (1987, 1988) found red-eared sliders to be abundant and widespread at Horseshoe Lake, and a large series of museum specimens (UMMZ) collected by M. B. Troutman in 1936 indicate this turtle has always been abundant there. We observed adults basking on logs, swimming in the lake, crossing roads, or dead on roads from 17 April through 21 October. According to Cahn (1937), these

turtles, if out of hibernation, escape floods by entering flooded lands and return to their original habitats when water recedes. Many hibernate under water (Ernst and Barbour, 1972). Females deposit eggs in depressions dug in open sandy areas (Cagle, 1950; Cahn, 1937), such as the cultivated fields around Horseshoe Lake. We saw a female in a field on 29 June. The young hatch in late autumn or overwinter in the nest (Cagle, 1950).

Five-lined Skink, Eumeces fasciatus. This woodland and woods-edge skink occurs throughout the Conservation Area and is abundant in sunny forest-edge habitat (Figure 13). Adults were observed during April, June, and July on fallen and rotting trees, under rotting logs, under trash, and under a pile of lumber. Most of the unidentified juveniles probably were this species but some undoubtedly were the very similar broadhead skink. Only the adults are readily identified with certainty. There are museum specimens from the 1950s and Brandon and Morris (1987) found this skink at several localities.

Broadhead Skink, Eumeces laticeps. Although seen less frequently and over a smaller area (Figure 5-13), probably because of its more arboreal habits, individuals were observed 23 and 28 April, 15 July, and 17 September, on fallen trees, on standing tree trunks, and in trash.

Worm Snake, Carphophis amoenus. Only one of these small, burrowing snakes was seen, in woods at the south end of the island on 23 April (Figure 5-14). Four museum specimens collected in the 1950s are labeled Horseshoe Lake;" they probably were found on the island.

Racer, Coluber constrictor. The racer does not appear to be common in the Conservation Area (Figure 5-14). Although the racer seems to be more characteristic of drier, more upland country, it can climb and swim and Smith (1961) reported it from the Horseshoe Lake area. A subadult was found under a log near the spillway, and remnants of eggs found at the east side of the area were identified as this species from their granular, leathery shells.

Rat Snake, Elaphe obsoleta. Individuals were found in April, July, August, and October in the island woods and on roads and railroad rights-of-way along the eastern edge of the Conservation Area (Figure 5-15), two of them stretched along tree limbs and three dead on roads. There are several P. W. Smith museum specimens from Olive Branch and Horseshoe Lake, collected in the 1950s. This snake frequently is reported climbing in trees, it feeds on birds.

Common Kingsnake, Lampropeltis getula. This snake apparently ranges across the area but cannot be considered

common (Figure 5-15). All but one animal (a juvenile found under trash) were found dead on a road. There are a few museum specimens collected in the 1940s, 1950s, and 1970s from the vicinity of Olive Branch and Horseshoe Lake.

Plainbelly Water Snake, Nerodia erythrogaster. This may be the most frequently seen water snake in the area (Figure 5-16) and it appears to be relatively abundant. One or more were seen on 6, 11, and 22 June, 12 August, and 7, 19 and 21 October, on logs, in water feeding on small fish, sheltered under concrete and tin, swimming in a ditch, stretched along tree branches over water, or dead on a road. They are known to have been in the area since before dam construction (museum specimens collected in 1907) and were collected by Smith in the 1950s (and illustrated in his 1961 report) and by Brandon and Morris (1987) and 1987.

Diamondback Water Snake, Nerodia rhombifer. Although not as many were seen, this snake may be nearly as abundant as the plainbelly water snake in the Horseshoe Lake and in quiet waters along Lake Creek (Figure 5-16). It seems more common in larger bodies of water where it eats fishes and amphibians. Individuals were observed 28 April, 6 and 11 June, 3 September, and 7 October, in a ditch feeding on fish, stretched along tree branches over water, or dead on a road. They were abundant at the spillway in 1987 and specimens collected in the early 1930s, 1940s, and 1950s are in museum collections.

Rough Green Snake, Opheodrys aestivus. Only two individuals of this cryptic, arboreal, forest-edge snake were found, both dead on a road on 14 July (Figure 5-17). It probably occurs throughout the area in bushes and vines overhanging the lake and other waters where it feeds on arthropods, but it is seldom noticed; it was known to occur at Horseshoe Lake (Smith, 1961). According to Morris (1982), adults are most active from April through October and eggs are laid by early July. Eggs have been found under a rock (Smith, 1961).

Brown Snake, Storeria dekayi. This small snake occurs in a variety of upland and lowland habitats, especially edges, where they feed mainly on earthworms and slugs (Ernst and Barbour, 1989; Smith, 1991). It often is abundant in marshlands, for example Kidd Lake Marsh, Monroe County (Brandon and Ballard, 1991) where hundreds were killed on an adjacent road, but it has been seen infrequently at Horseshoe Lake. P. W. Smith found one in the 1950s and we found one in the island forest on 23 April. It appears to be more abundant where upland sites are available for hibernation.

Redbelly Snake, Storeria occipitomaculata. These small nocturnal, live bearing snakes usually are found under rocks,

leaves, or leaf debris in moist forests where they specialize in feeding on slugs but eat a variety of other invertebrates as well (Ernst and Barbour, 1989). Individuals have been found climbing in vegetation (Smith, 1961). There are museum records from the Horseshoe Lake island dating from the 1960s, and we observed one on 23 April.

Western Ribbon Snake, Thamnophis proximus. This semi-aquatic snake is common in the Mississippi River valley of southern Illinois where it lives in bordering vegetation of permanent or nearly permanent marshes, ponds, sloughs, streams and swamps, feeding mainly on amphibians (Ernst and Barbour, 1989; Rossman, 1963; Smith, 1961; Tinkle, 1957). It was observed at Horseshoe Lake 15 July (4 adults and one subadult), 12 August (a newborn), and 24 August (an adult), at the eastern end of the Conservation Area (Figure 5-18). In 1979 and 1987 (Brandon and Morris, 1987) they also were seen in the vicinity of the spillway and along the shore of the Miller City arm of the lake. There are museum specimens from the 1950s.

Common Garter Snake, Thamnophis sirtalis. This is a common terrestrial snake of moist forest-edge habitats, where it feeds mainly on frogs, salamanders, earthworms, fish (Ernst and Barbour, 1989; Fitch, 1965; Smith, 1961). Individuals were found dead on a road (14 July), under trash, boards, and logs (15 July, 24 August and 17 September), on a railroad embankment (12 August, 2 newborn), and under logs in woods (22 July and 17 September) (Figure 5-19). There are Horseshoe Lake museum specimens from the 1950s. Garter snakes are known to hibernate in a variety of sites ranging from hollow logs and stumps to mammal burrows, crayfish burrows, stone causeways and earth dams (Ernst and Barbour, 1989). Individuals commonly have been seen swimming along shores and others have been found in shrubs (Ernst and Barbour, 1989), so they seem able to escape flood waters well.

Surveys for Threatened and Endangered Species

The following four species observed or previously reported from the Horseshoe Lake area are listed as threatened or endangered in Illinois: Illinois chorus frog (Pseudacris streckeri illinoensis), river cooter (Pseudemys concinna), broad-banded water snake (Nerodia fasciata confluens), Mississippi green water snake (Nerodia cyclopion). Of these, only the Illinois chorus frog was observed during this survey. The dusky salamander (Desmognathus conanti), called Desmognathus fuscus until Karlin and Guttman (1986) clarified the relationships between these two taxa, occurs in the upland east of Cache River but not in the Horseshoe Lake lowlands. The timber rattlesnake (Crotalus horridus) occurs in the hills immediately northwest

of Olive Branch but there seem to be no records for the Horseshoe Lake lowlands.

Illinois Chorus Frog. This frog, described by P. W. Smith in 1951, was not known to occur south of the Illinois River valley until Smith (1955) found a population in the Missouri boot heel and Holman et al. (1964) subsequently discovered a population "...1 mile west of Horseshoe Lake Conservation Area,..." Holman et al. caught 18 males from flooded land on March 6. Smith (1966), in a summary of current knowledge of the species Pseudacris streckeri, illustrated a string of populations extending from extreme southeastern Missouri northward into the Horseshoe Lake area. Later, Axtell and Haskell (1977) located populations in Madison County, Illinois, and discussed the zoogeography of the species. Still more recently, Gilbert (1986) found a population in Monroe County. Thus, there are known in Illinois three major clusters of populations, nicely mapped by Axtell and Haskell (1977), one along the Illinois River, one in the St. Louis metro-east area, and one in southeastern Missouri and the adjacent Horseshoe Lake area.

Subsequent to the original report of P. streckeri west of Horseshoe Lake, Brown and Brown (1973) noted two additional localities in the vicinity of the lake, in Miller City (5 March 1971), northeast of Olive Branch (19 April, 1973).

Brown et al. (1972) demonstrated that these sand-prairie inhabitants are truly fossorial and dig through sandy soils with their forelimbs. Most juvenile and adult activity takes place underground and animals are seldom seen outside of the early spring breeding season. Without careful field work at the right time of year and during the proper weather, populations easily escape notice. These adults emerge and move to temporary pools in cultivated fields and ditches to breed during late winter and very early spring-February into April. The tadpoles are relatively large before transforming.

In a survey of breeding populations in the state, Taubert et al. (no date) observed three sites in Alexander County, all north of Olive Branch.

The Illinois chorus frog is widely distributed in the sandy soils of the Horseshoe Lake area (Figure 5-4) where it reproduces in pools and ditches in cultivated fields, and along edges of woods and roads. During 1992-1994 breeding Illinois chorus frogs were found to be widely distributed throughout the sandy bottomland soils of Alexander County, including Horseshoe Lake Conservation Area, from Sandy Creek in the north to Willard in the south. They would have to be considered common. Calling males were noted from a dozen sites within the Conservation Area, 3 sites as far south

toward Dogtooth Bend as Willard, 14 sites to the west between the Conservation Area and the Mississippi River, and nearly 20 sites north of the Conservation Area as far as Sandusky. Males were heard calling, usually only a few (2-5) at a time, on 13 dates from 10 February through 9 April. The number of calling males heard at any one time probably is an underestimate of population size. At one pond where only 4 males had been calling a week earlier, we found 38 egg masses. Many of the plotted localities are based on breeding calls heard in the vicinity. A few individuals were found on roads during or following rain, both during and after the breeding season (26 March, 10 April, 14 July).

Plotted localities on the distribution map (Fig. 5-4) come from literature records, a few voucher specimens taken during this study, observations of adults and/or tadpoles in breeding ponds, and call survey data much of which was provided by Todd Fink and other Natural Heritage biologists. Some of the call locations are approximate because calls carry well are were difficult to pinpoint. Verified breeding sites (adults and/or tadpoles subsequently reared in the laboratory), places where adults or subadults were seen away from breeding sites, and published localities are plotted on Figure 5-20.

River Cooter. First reported from the Horseshoe Lake area by Cahn (1937), this is an omnivorous turtle of large rivers and lakes. Cahn noted that it was exterminated from Horseshoe Lake during the summer of 1930 when the lake went dry, after the first dam was washed out and the lake lay dry for a year (Bogner et al., 1985), and that it had not returned as of 1933. There is, however, a specimen in the INHS collected in 1936 (INHS 2155) and another collected in 1951 (INHS 6014). Before being protected by the Fayville levee from Mississippi River flood water in 1969, a Horseshoe Lake population probably was recharged periodically by new individuals carried in from the river. Despite always being regarded as uncommon to rare in the state, Cahn (1937:156-157) noted that Horseshoe Lake was "...a congenial habitat,..." for this turtle. The only specimen known from Horseshoe Lake in recent years was an adult female that Mike Morris found dead at the spillway in April 1985 (Moll and Morris, 1991). Efforts should be made to examine whether the floods of 1993 and 1994 replenished this population.

Broad-banded Water Snake. Smith (1961), whose book on the Illinois herpetofauna was published before Conant (1963) had clarified the status of Nerodia fasciata as a species distinct from N. sipedon, treated southern Illinois broad-banded water snakes as a subspecies of the northern water snake. All known specimens are from the vicinity of Horseshoe Lake. Five CNHM specimens (2227, 2139, 2230-2231, 2235, and 2238) were collected in 1907; one specimen was

collected in 1929 (UIMNH 16875), one in 1951 (INHS 6022), and the most recent two in 1956 (AMNH 88318 and SIUC photo). Localities given were Olive Branch, Horseshoe Lake, Horseshoe Lake spillway, and Horseshoe Lake dam. No individual has been seen since 1956 despite intensive searching efforts in the vicinity of the dam and spillway, as well as elsewhere at Horseshoe Lake. The species, never common, apparently has been extirpated from the state. Perhaps its tenuous foothold in Illinois was lost as its seasonally variable cypress swamp, river slough, and oxbow lake habitats became stabilized by levees and the water level of Horseshoe Lake was stabilized by the dam.

Mississippi Green Water Snake. This snake has been known from Bluff Lake, Union County, since the last century (Garman, 1892) and there are CNHM specimens collected near Olive Branch in 1907 (Keiser, 1958). Although many animals have been seen at Pine Hills/Wolf Lake in recent years (Garton et al., 1970; S. Ballard current studies), none has been seen at Horseshoe Lake during this century. Water level in Horseshoe Lake has been stabilized, and its associated cypress swamps have been degraded significantly since dam construction. The Mississippi green water snake may have been extirpated at this locality.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON HERPETOFAUNA AND MANAGEMENT RECOMMENDATIONS

The following assessments and recommendations are made within the context of the history of Horseshoe Lake outlined by Bogner, et al. (1985), their description of the cyclic drying and flooding that occurred prior to formation of a permanent lake, and on current understanding of the habitat requirements of various elements of the herpetofauna. Some species seem to have been harmed when water level of the lake was stabilized by dams and flood waters were excluded (most years) by levees. It does not seem likely that further elevation of the lake by two feet would have further negative impact on these species, two of which (Mississippi green water snake [threatened] and broad-banded water snake [endangered])may already have been extirpated. It remains to be seen whether the 1993 and 1994 floods have recharged the population of river cooter (endangered) in the lake.

The remainder of the herpetofauna of the area can be classified as inhabitants of (1) austroriparian swamps, (2) lowland forest, (3) upland forest and flowing streams, (4) sandy alluvial ridges, (5) general aquatic habitats, (6) general forest or forest edge habitats, and (7) large rivers.

(1) These species seems adapted to the shallow, bottomland cypress and tupelo swamps characteristic of the Coastal Plain physiographic province. These swamplands formerly dried up regularly in July and August and were periodically subjected to Cache River backwater flooding and Mississippi River floods. These species thrive in habitats subjected to periodic flooding and drying. Examples are: bird-voiced treefrog, green treefrog, pickerel frog, mud snake, Mississippi green water snake, broad-banded water snake, plainbelly water snake, diamondback water snake, and cottonmouth. These are the species that were most negatively affected when Horseshoe Lake was stabilized and overland flooding was reduced by levees. Raising the water level of the lake by another two feet should have no negative affect on them.

(2) These species thrive in lowland forest elevated above the cypress swampland, where seasonal fish-free rain pools teem with invertebrates and amphibians during winter and spring and usually dry out in autumn. Examples are: ambystomatid salamanders, central newt, siren, American toad, Fowler's toad, cricket frog, Cope's gray treefrog, spring peeper, upland chorus frog, bullfrog, southern leopard frog, eastern box turtle, five-lined and broadhead skinks, worm snake, rat snake, common king snake, brown snake, western ribbon snake, garter snake, earth snake, and copperhead. Some of these-ambystomatid salamanders, worm snake, brown snake-spend much of the year burrowed into the soil and a two-foot rise in the water table under the island forest could eliminate a considerable amount of their subsurface habitat, reduce their food supply, and expose them to increased predation. Populations particularly in the island forest should monitored for negative impact.

(3) The species characteristic of more upland forest and flowing streams and are rare within the Conservation Area, most of them being known only from the island forest. Examples are: longtail salamander, slimy salamander, ringneck snake, red milk snake, northern water snake, rough green snake, redbelly snake, and earth snake. With an elevated water table under the island forest, some of these species would find this an even more marginal habitat than it already is. These populations should be monitored periodically.

(4) A few species are associated with sandy alluvial ridges that formerly supported remnants of the Prairie Peninsula but now are under cultivation. Examples are: Illinois chorus frog, plains leopard frog, eastern spadefoot, and eastern hognose snake. These habitats are high enough to be unaffected by a two-foot rise in level of the lake.

(5) Species found in nearly any aquatic habitat of the area include: lesser siren, central newt, bullfrog, green

frog, southern leopard frog, snapping turtle, common musk turtle, painted turtle, red-eared slider, spiny softshell, plainbelly water snake, and diamondback water snake. Raising the water level would provide a more habitat for these species by increasing water volume and area of shoreline.

(6) General forest or forest edge inhabitants include: slimy salamander, American toad, Fowler's toad, Cope's gray treefrog, spring peeper, southern leopard frog, eastern box turtle, fence lizard, five-lined skink, broadhead skink, worm snake, racer, ringneck snake, rat snake, common kingsnake, red milk snake, rough green snake, brown snake, redbelly snake, common garter snake, earth snake, and copperhead. With an elevated water table under the lower-elevation forests, habitat for some of these species would be reduced. Therefore, these populations should be monitored periodically.

(7) Found mainly in rivers are: river cooter, map turtle, false map turtle, and smooth softshell. Elevated lake level would provide additional habitat for these species once they reached the lake.

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Schneider (University of Michigan Museum of Zoology), Aine Shiozaki (University of Illinois Museum of Natural History), Ron Vasile (The Chicago Academy of Sciences), Kathryn Vaughan (Texas Cooperative Wildlife Collection), Jens V. Vindum (California Academy of Sciences), David B. Wake (Museum of Vertebrate Zoology, Berkeley), John Wright (Natural History Museum of Los Angeles County).

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Table 5-1. Relative abundances of species of amphibians and reptiles observed in the Horseshoe Lake area during the period April 1993 - April 1994. Species previously reported but not seen during this survey are marked with an asterisk.

	Widespread & abundant	Widespread & uncommon	Localized	Rare
Class Amphibia				
Order Caudata				
Family Ambystomatidae				
Ambystoma maculatum			X	
Ambystoma opacum			X	
Ambystoma talpoideum			X	
Ambystoma texanum	X			
Family Salamandridae				
**Notophthalmus viridescens*				
Family Plethodontidae				
**Eurycea longicauda*				
Plethodon glutinosus			X	
Family Sirenidae				
Siren intermedia		X		
Order Anura				
Family Pelobatidae				
Scaphiopus holbrookii		X		
Family Bufonidae				
Bufo americanus		X		
Bufo woodhousii	X			
Family Hylidae				
**Hyla avivoca*				
Acris crepitans	X			
Hyla chrysoscelis	X			
Hyla cinerea	X			
Pseudacris crucifer	X			

	Widespread & abundant	Widespread & uncommon	Localized	Rare
Pseudacris feriarum	X			
Pseudacris streckeri		X		
Family Ranidae				
Rana blairi		X		
Rana catesbeiana	X			
Rana clamitans			X	
**Rana palustris*				
Rana sphenocephala	X			
Class Reptilia				
Order Testudines				
Family Chelydridae				
Chelydra serpentina		X		
Family Kinosternidae				
Sternotherus odoratus	X			
Family Emydidae				
Chrysemys picta	X			
**Graptemys geographica*				
**Graptemys pseudogeographica*				
**Pseudemys concinna*				
Trachemys scripta	X			
Terrapene carolina	X			
Family Trionychidae				
**Apalone mutica*				
**Apalone spinifera*				
Order Lacertilia				
Family Iguanidae				
**Sceloporus undulatus*				
Family Scincidae				
Eumeces fasciatus	X			
Eumeces laticeps		X		

	Widespread & abundant	Widespread & uncommon	Localized	Rare
Order Serpentes				
Family Colubridae				
Carphophis amoenus				X
Coluber constrictor				X
**Diadophis punctatus*				
Elaphe obsoleta		X		
**Farancia abacura*				
**Heterodon platirhinos*				
Lampropeltis getula		X		
**Lampropeltis triangulum*				
**Nerodia cyclopion*				
**Nerodia fasciata*				
Nerodia erythrogaster	X			
Nerodia rhombifer	X			
**Nerodia sipedon*				
Opheodrys aestivus				X
Storeria dekayi				X
Storeria occipitomaculata				X
Thamnophis proximus		X		
Thamnophis sirtalis		X		
**Virginia valeriae*				
Family Viperidae				
**Agkistrodon contortrix*				
**Agkistrodon piscivorus*				

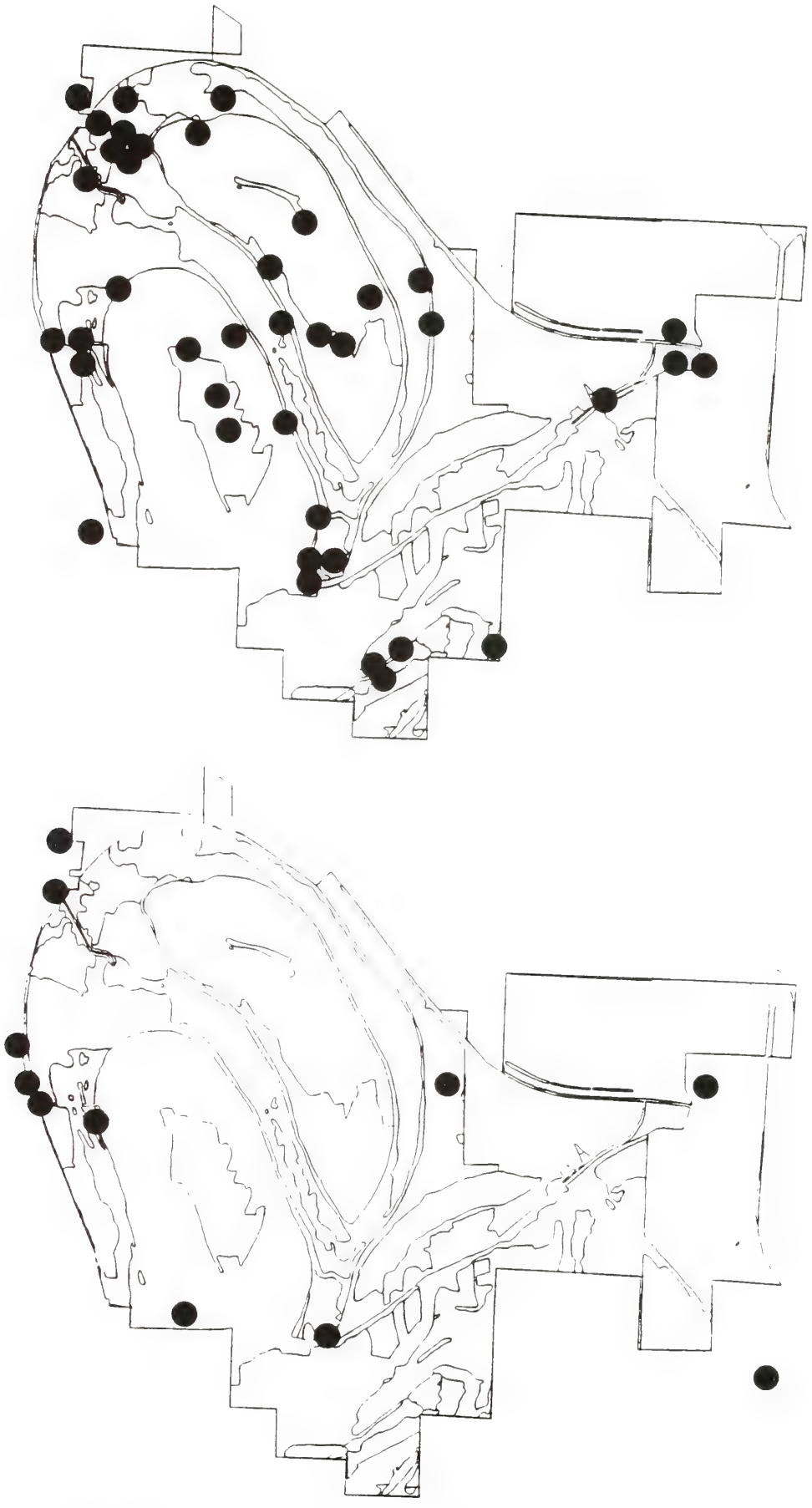

FIGURE 5-1. Cricket frog, Acris crepitans (above); American toad, Bufo americanus (below).

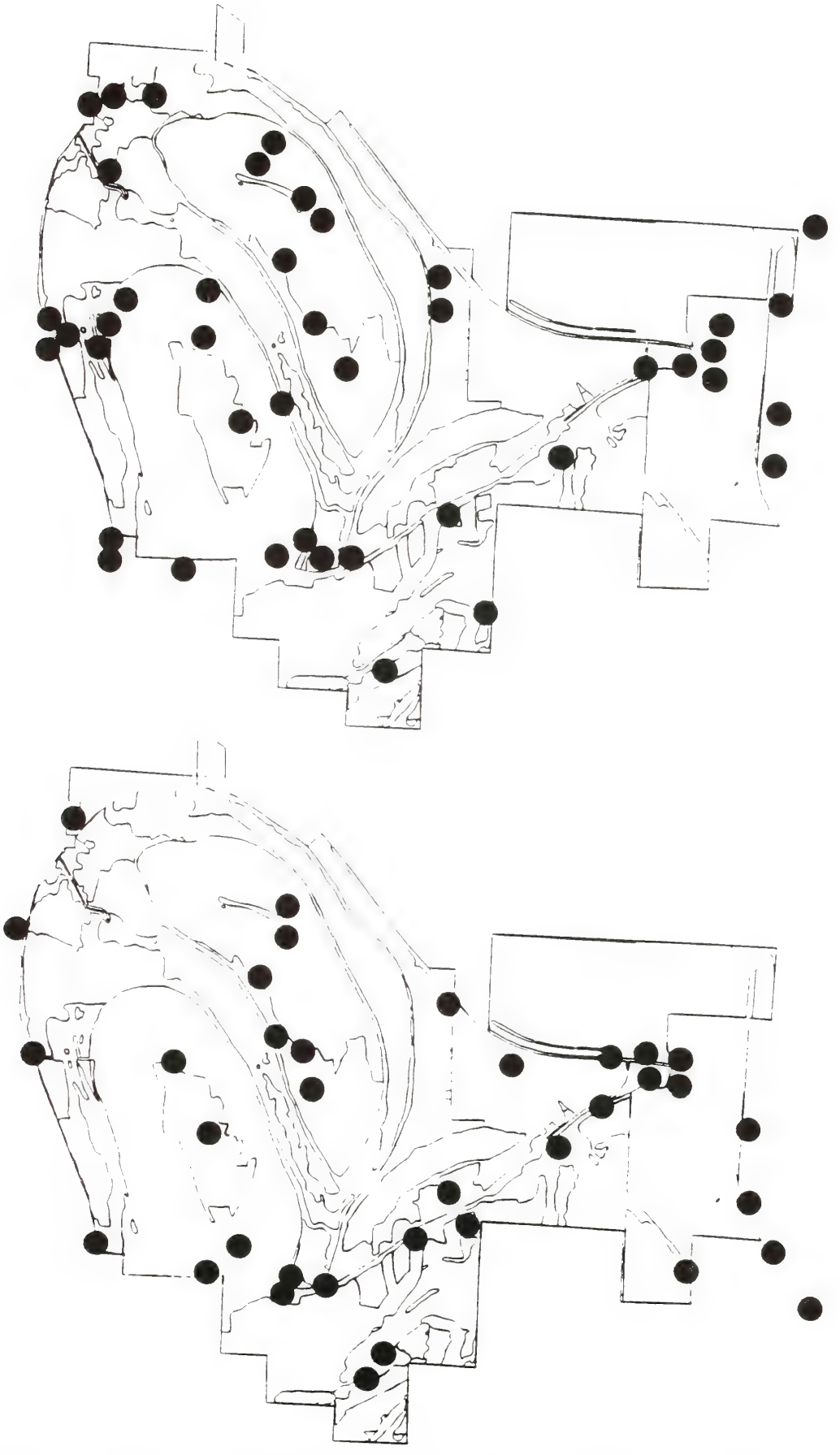

FIGURE 5-2. Fowler's toad, Bufo woodhousii (above); Cope's gray treefrog, Hyla chrysoscelis (below).

FIGURE 5-3. Green treefrog, Hyla cinerea (above); spring peeper, Pseudacris crucifer (below).

FIGURE 5-4. Upland chorus frog, Pseudacris feriarum (above); Illinois chorus frog, Pseudacris streckeri (below).

FIGURE 5-5. Plains leopard frog, Rana blairi (above); bullfrog, Rana catesbeiana (below).

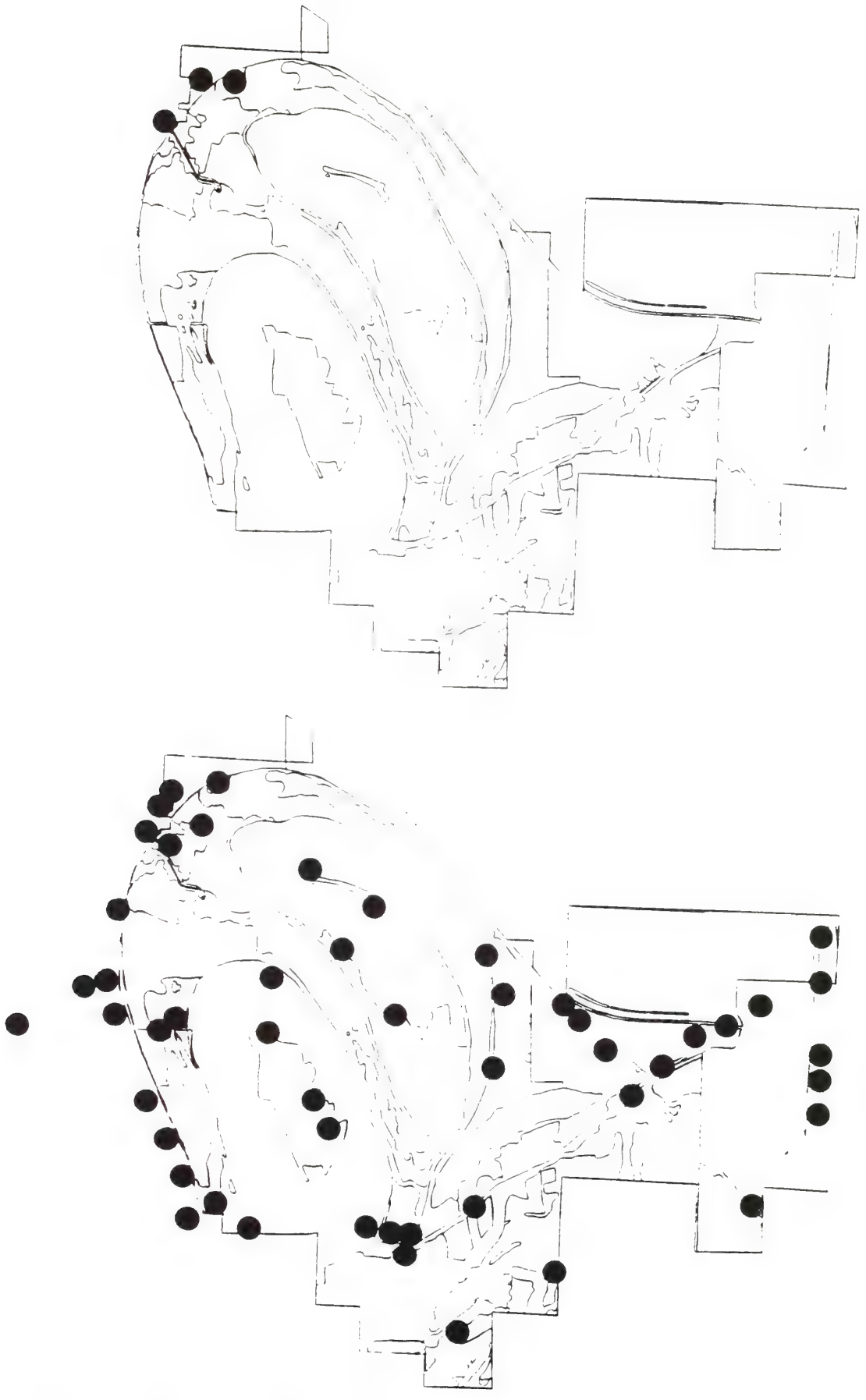

FIGURE 5-6. Green frog, Rana clamitans (above); southern leopard frog, Rana sphenocephala (below).

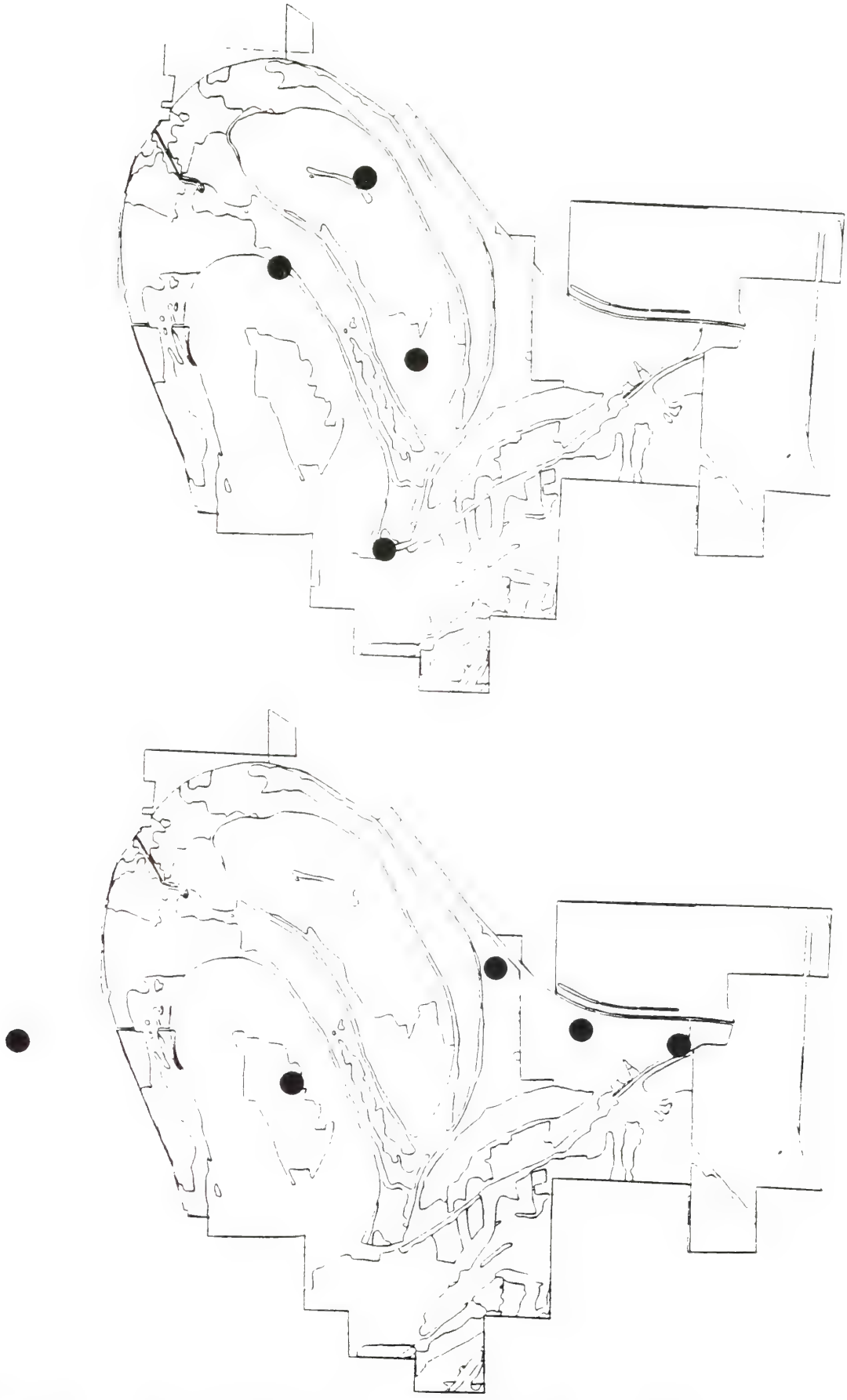

FIGURE 5-7. Eastern spadefoot, Scaphiopus holbrookii (above); spotted salamander, Ambystoma maculatum (below).

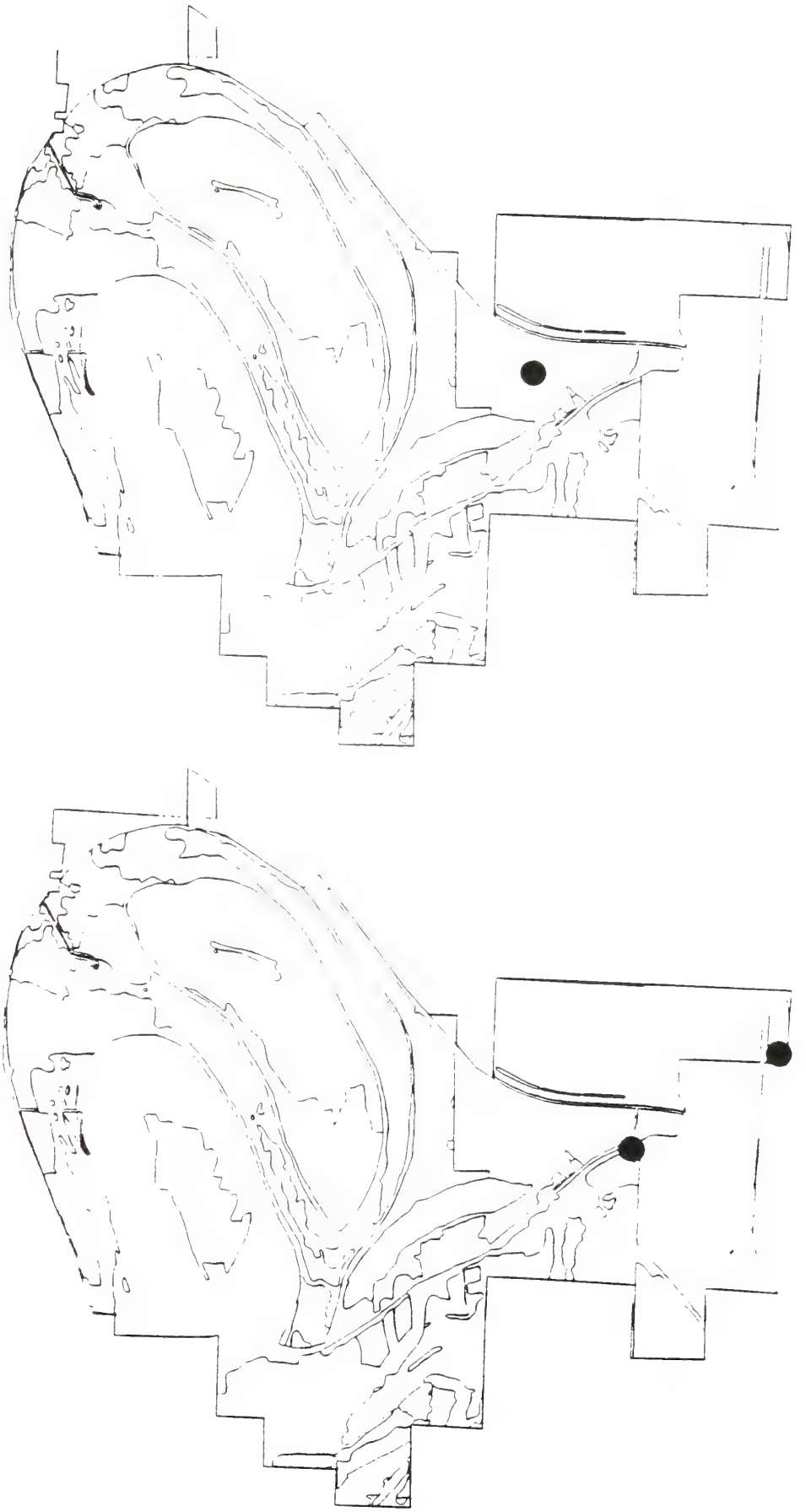

FIGURE 5-8. Marbled salamander, Ambystoma opacum (above); mole salamander, Ambystoma talpoideum (below).

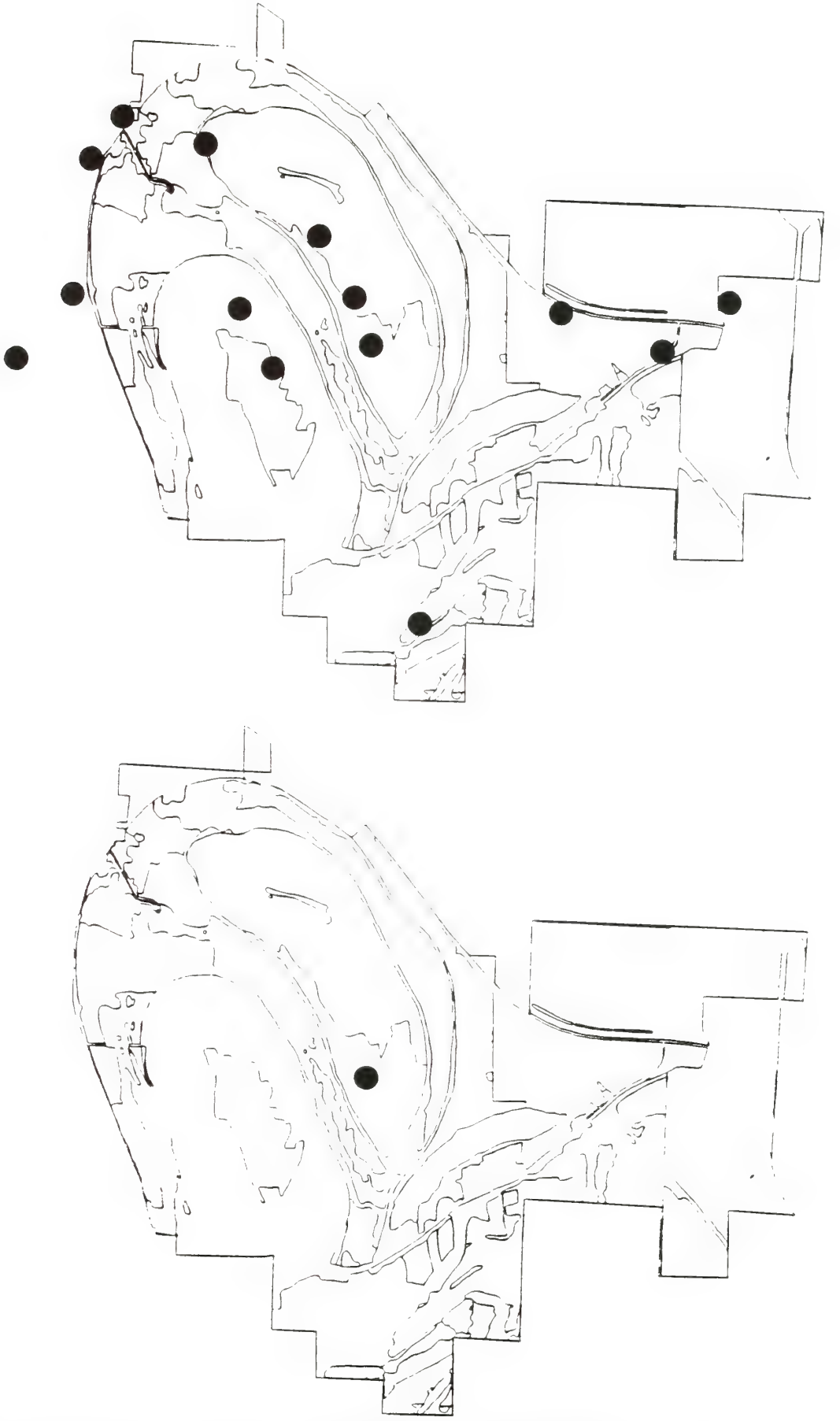

FIGURE 5-9. Smallmouth salamander, Ambystoma texanum (above); northern slimy salamander, Plethodon glutinosus (below).

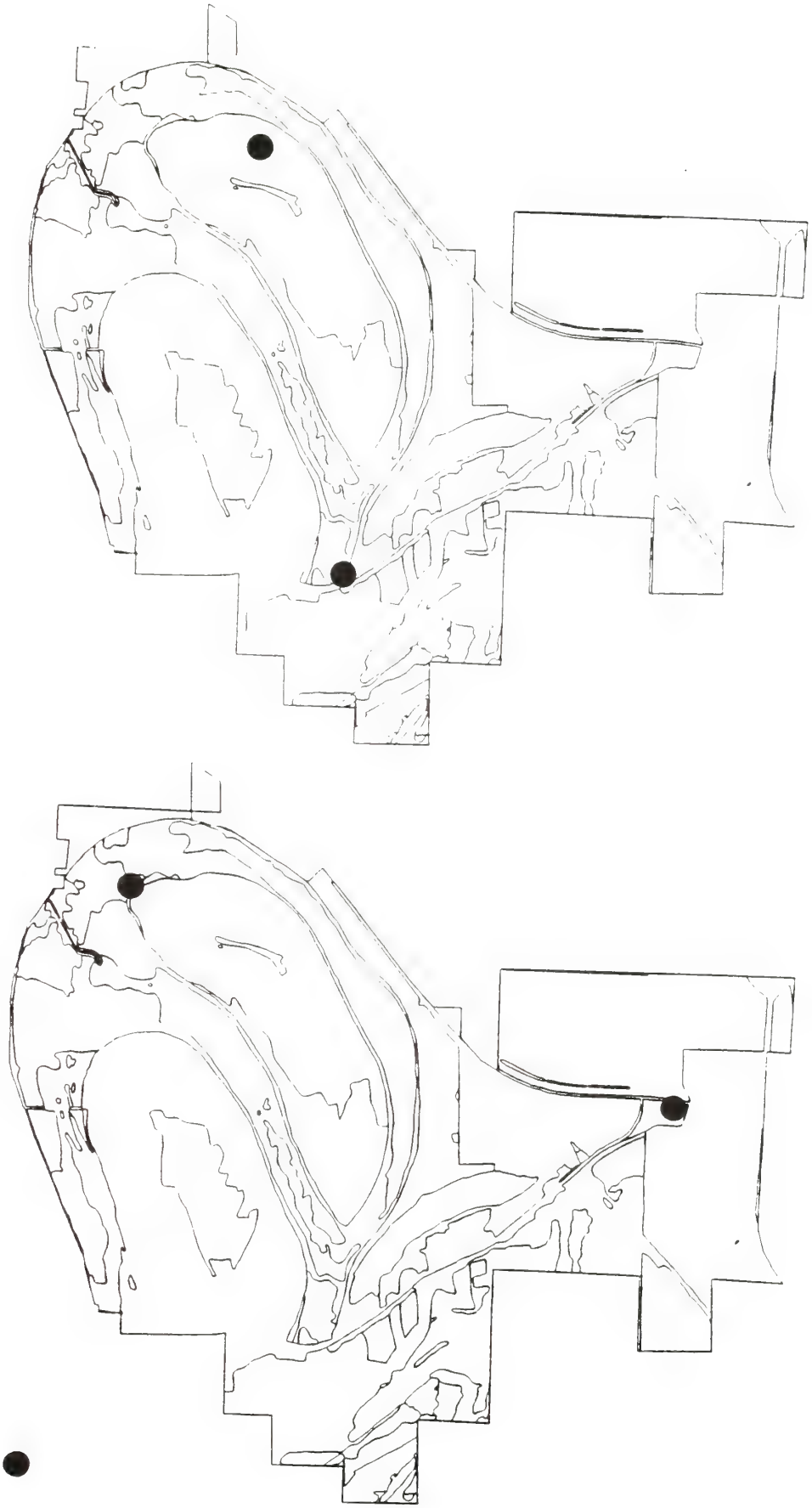

FIGURE 5-10. Lesser siren, Siren intermedia (above); snapping turtle, Chelydra serpentina (below).

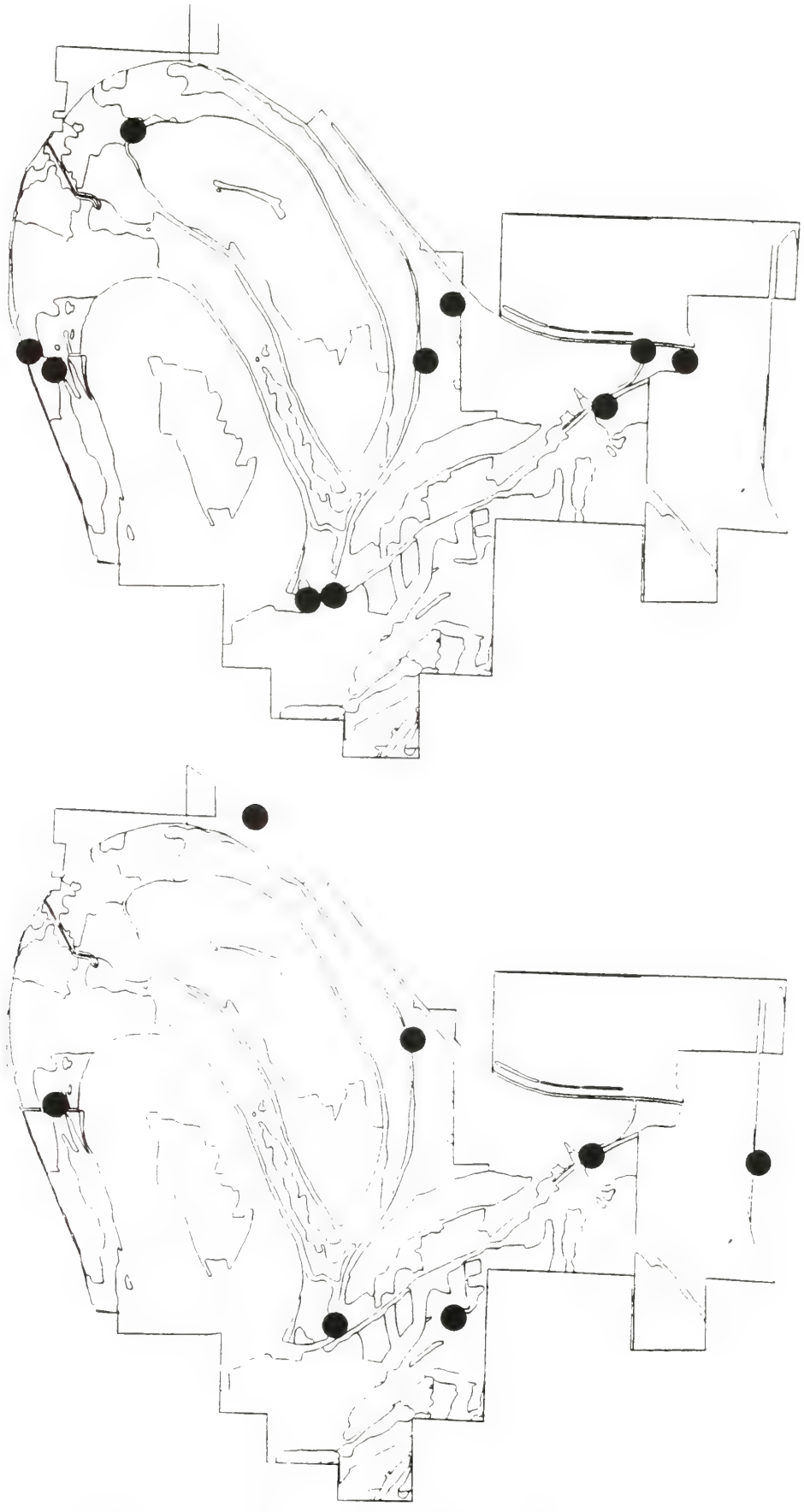

FIGURE 5-11. Painted turtle, Chrysemys picta (above); common musk turtle, Sternotherus odoratus (below).

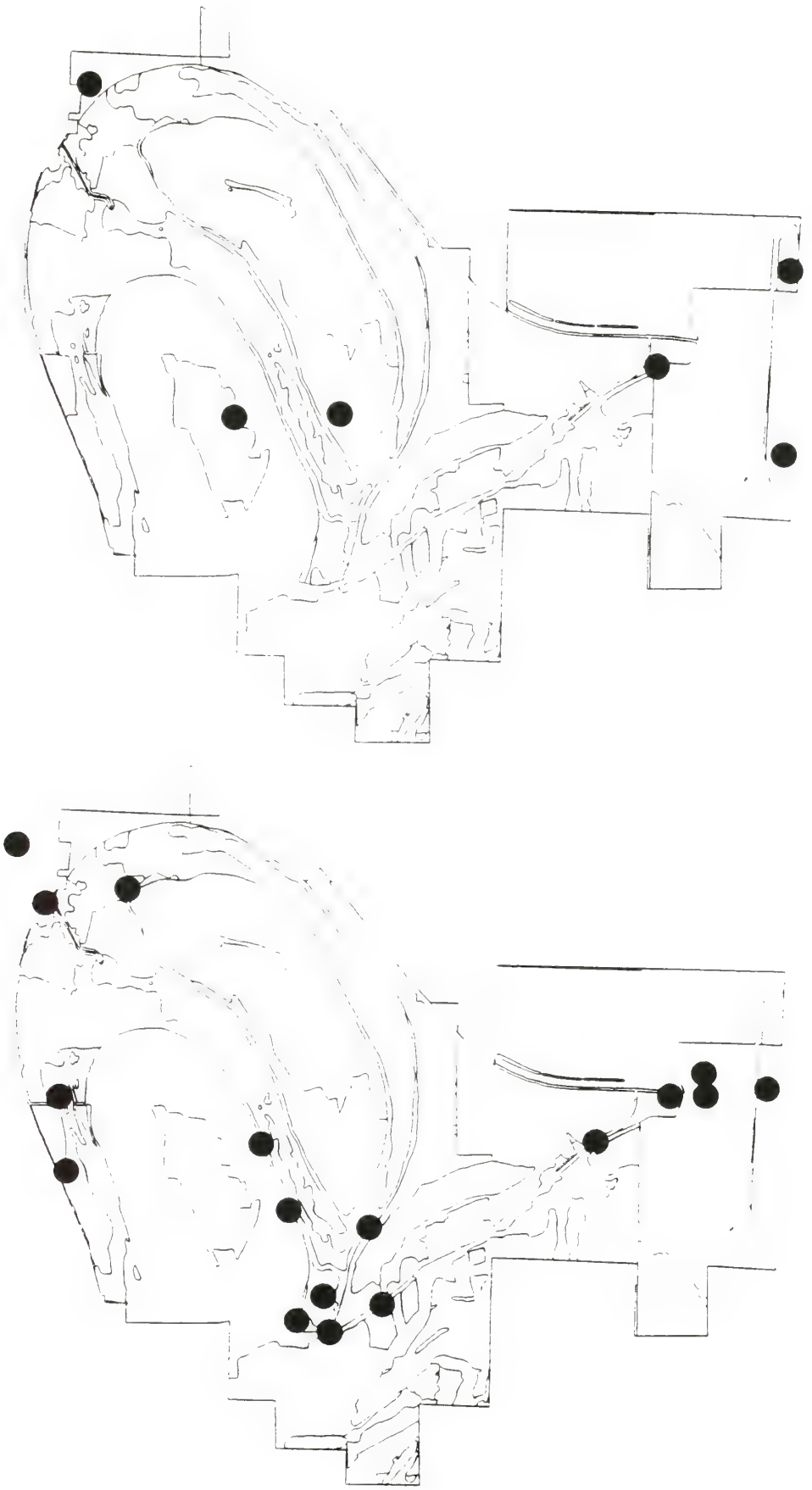

FIGURE 5-12. Eastern box turtle, Terrapene carolina (above); slider, Trachemys scripta (below).

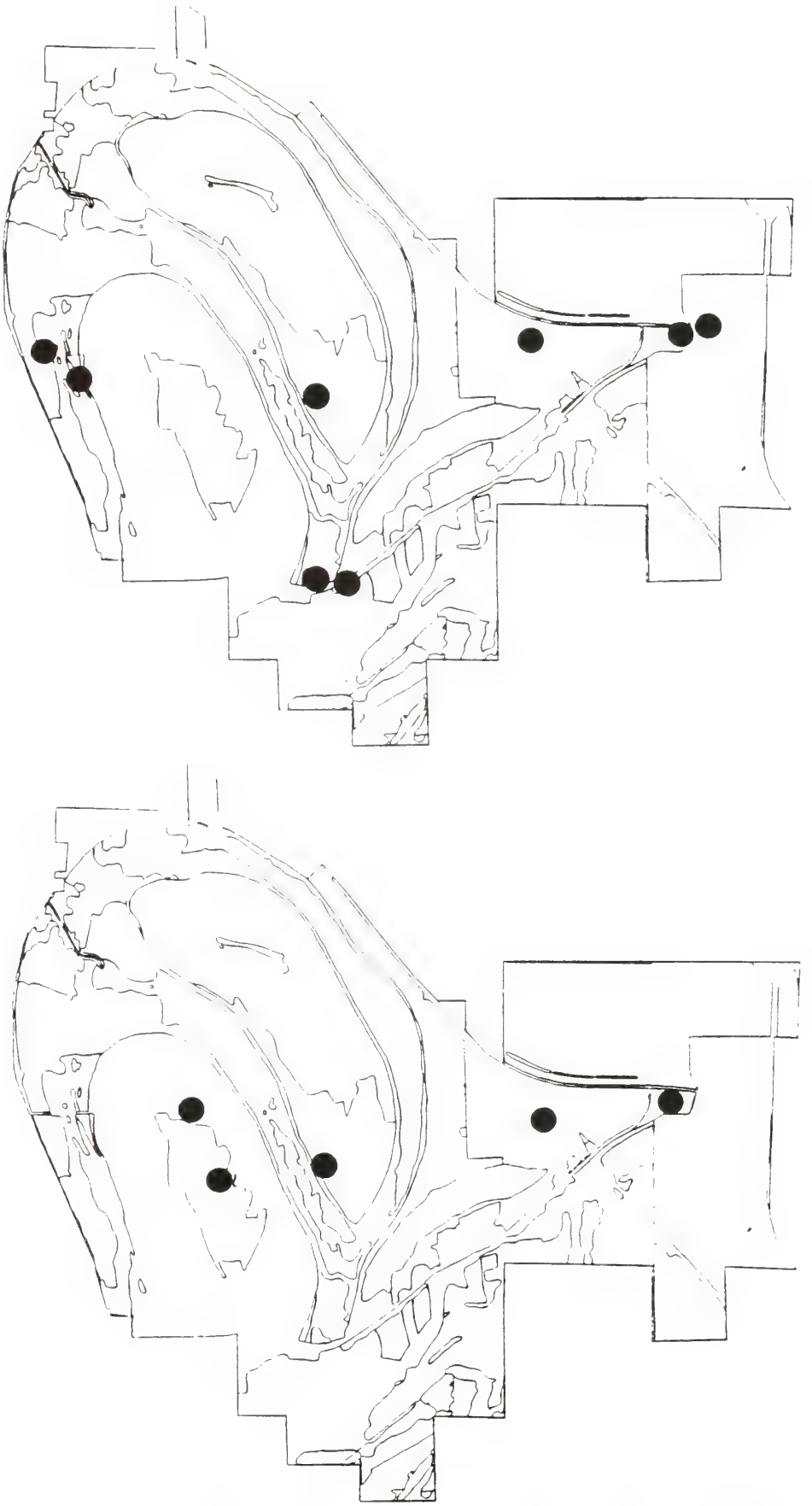

FIGURE 5-13. Five-lined skink, Eumeces fasciatus (above); broadhead skink, Eumeces laticeps (below).

FIGURE 5-14. Worm snake, Carphophis amoenus (above); racer, Coluber constrictor (below).

FIGURE 5-15. Rat snake, Elaphe obsoleta (above); common kingsnake, Lampropeltis getula (below).

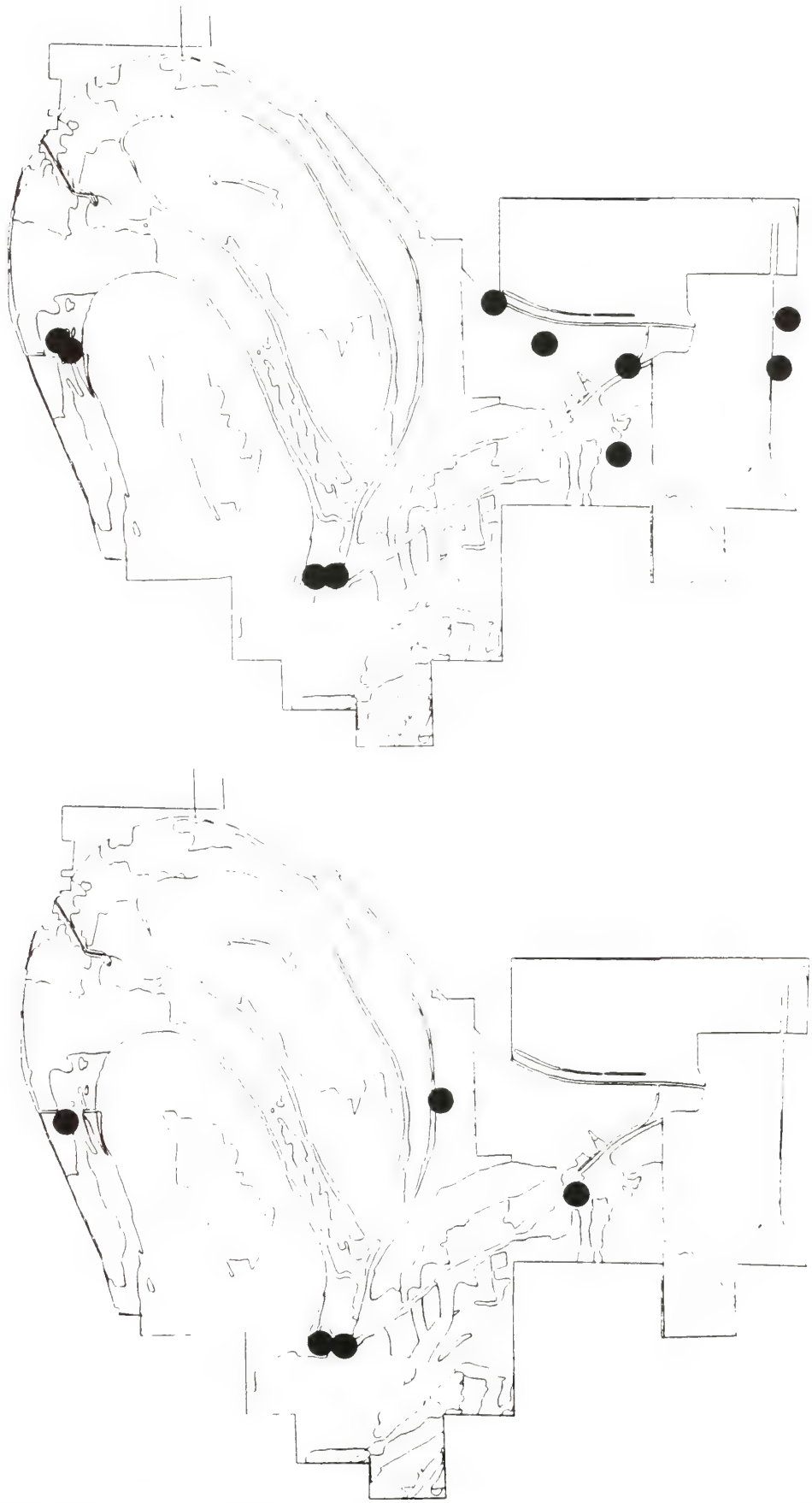

FIGURE 5-16. Plainbelly water snake, Nerodia erythrogaster (above); diamondback water snake, Nerodia rhombifer (below).

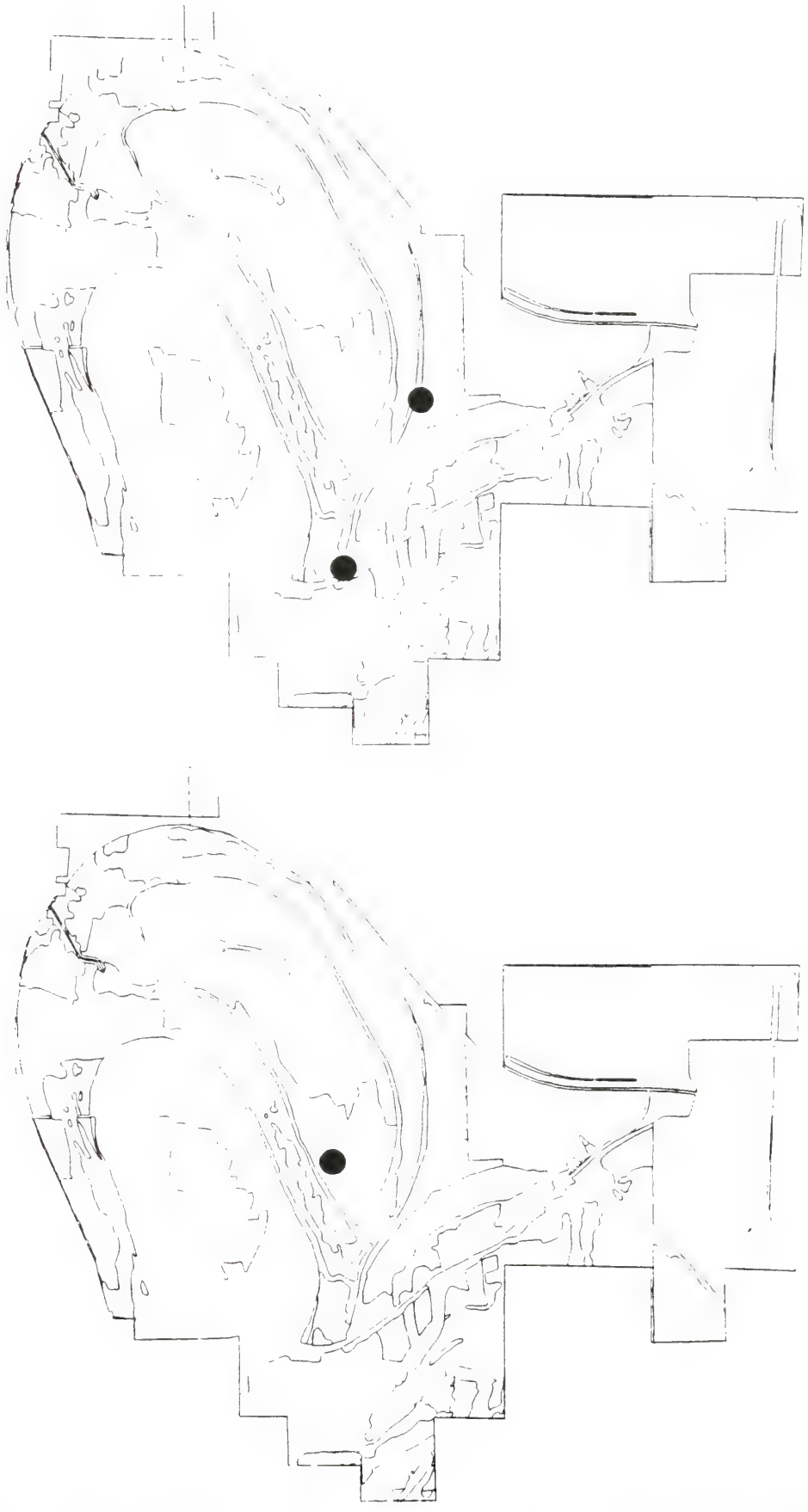

FIGURE 5-17. Rough green snake, Opheodrys aestivus (above); brown snake, Storeria dekayi (below).

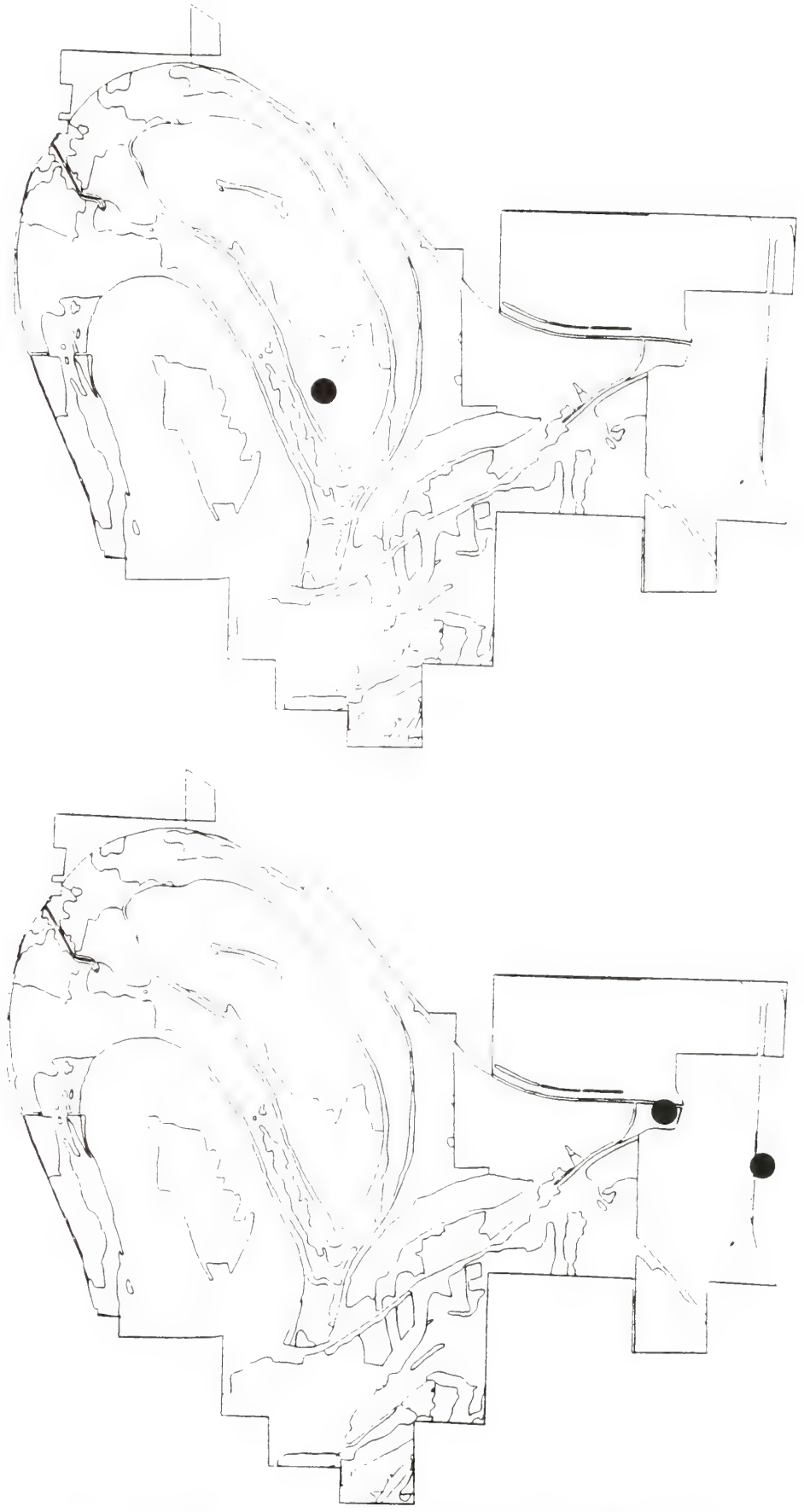

FIGURE 5-18. Redbelly snake, Storeria occipitomaculata (above); western ribbon snake, Thamnophis proximus (below).

FIGURE 5-19. Common garter snake, Thamnophis sirtalis.

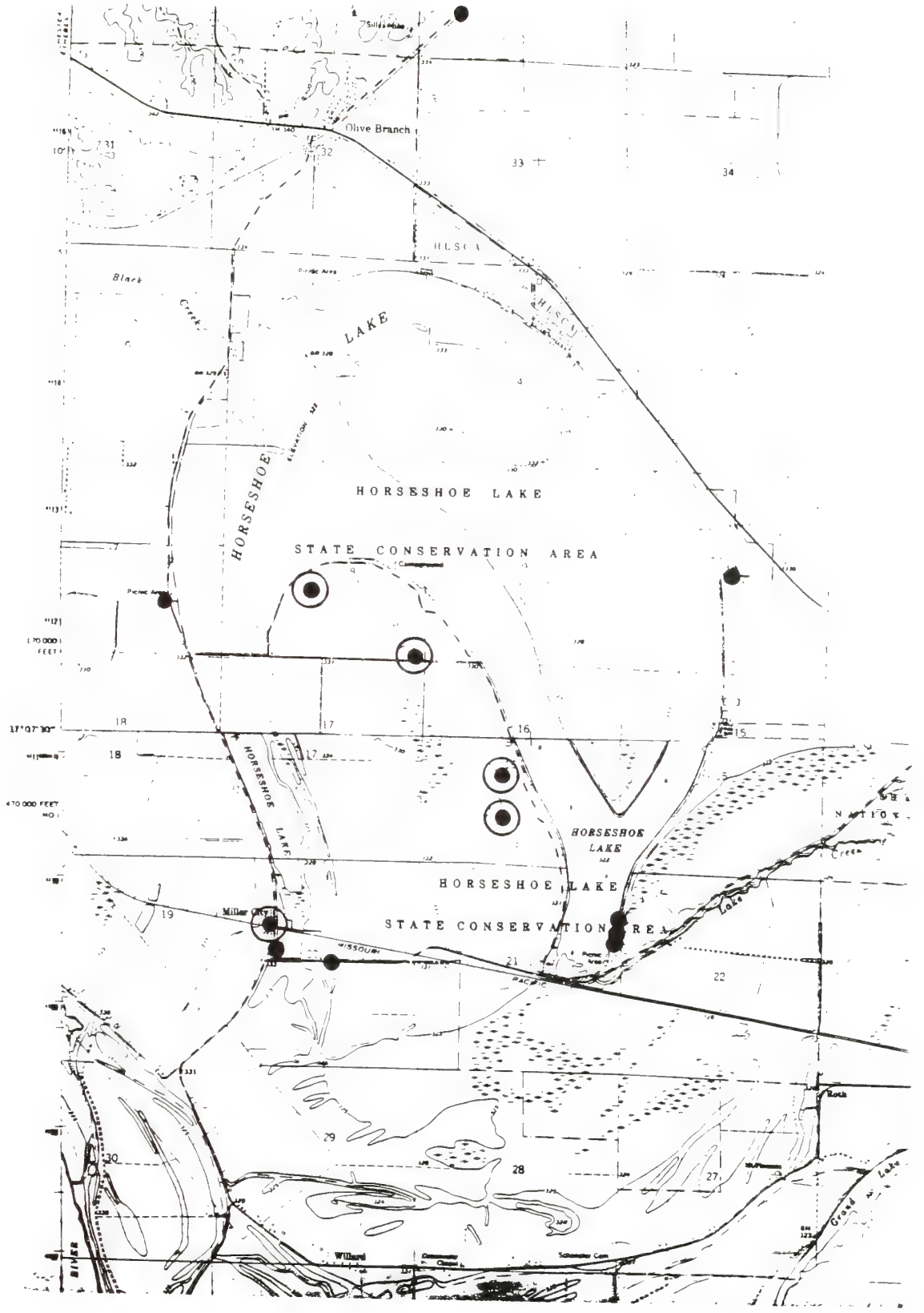

FIGURE 5-20. Sites where Illinois chorus frogs were seen on roads (solid dots) and confirmed breeding ponds (circled dots) during 1993-1994.

JOB 6. AVIAN COMMUNITY SURVEYS

Robert J. Gates and Jay Rubinoff

PART ONE

SURVEY

Introduction

Evans and Klimstra (1982) conducted an avian ecological investigation at Horseshoe Lake CA in 1982. That survey recorded 115 species, 89 of which were considered resident; 26 were migrant birds. Four of the resident species were Illinois state endangered, including Mississippi kite (Ictinia mississippiensis), red-shouldered hawk (Buteo jamaicensis), great egret (Casmerodius albus) and little blue heron (Egretta caerulea). Two state threatened species were also recorded by Evans and Klimstra (1982): loggerhead shrike (Lanius ludovicianus), a resident; and veery (Catharus fuscescens), a migrant. We compare results of the 1993 avian ecological investigation with that conducted by Evans and Klimstra (1982).

Objective

The objective of this portion of the study was to determine the distribution and relative abundance of spring/summer resident and breeding birds present within Horseshoe Lake CA.

Methods

Transects and census stops used by Evans and Klimstra (1982) were revisited during the 1993 survey (Figure 6-1). Transects and census stops were not permanently marked, but were readily located in the field after referring to topographic maps, aerial photographs, and maps provided by Evans and Klimstra (1982). We moved six of the qualitative census stops (not located on transects) used by Evans and Klimstra (1982) to enhance our coverage of the area likely to be impacted by increasing lake levels. Four stops (51-54) used by Evans and Klimstra (1982) were moved to new locations; two stops (50 and 55) were combined.

Census stops were digitized on vegetation community maps developed by interpretation of aerial photographs as described in Job 2 (Vegetation Mapping). Predominant vegetation types at each census stop were recorded after overlaying transect routes and census stops on digitized vegetation maps. Woody and herbaceous vegetation present at census stops along transects 1, 2, and 5 were recorded in

mid-June and early July, concurrent with work conducted under Job 4 (Plant Community Surveys) before floodwaters inundated the area. Vegetation was not recorded on the remaining census stops since understory vegetation was largely destroyed after floodwaters receded in fall. Copies of vegetation stratum field forms for transects 1, 2, and 5 are included in Appendix 6-1.

Censuses were conducted between 27 May and 26 June 1993. Standard methods of the Illinois Department of Conservation avian ecological investigations (AEI) were followed. Each transect was visited a minimum of 4 times during the study, approximately once per week. Surveys began at sunrise and were completed between 0930 and 1200 hrs. Completion of surveys before 1000 hrs as specified for an AEI was often not possible due to high water levels on some transects early in the study period. Observers stopped at 0.5 mile intervals for 10 minutes and recorded the numbers and species of birds heard or seen from all census stops. Birds seen or heard between census stops were also recorded. Evidence of breeding and presence of migrants (downy young, nests observed) were documented in the course of avian surveys and other field activities.

Four surveys for crepuscular/nocturnal birds were conducted during the study (once per week). Only those census stops located in areas likely to harbor crepuscular or nocturnal birds such as owls, rails, and caprimulgids were visited. Recorded calls were played back over a 15 min period to elicit responses from owls, rails and other wading birds. Birds seen or heard responding to recorded calls were recorded at each stop.

All surveys were conducted under optimum field conditions (relatively clear, calm days with no more than light precipitation). Persons conducting surveys (Rubinoff and Smout) were experienced observers proficient with species identification from songs, calls, and visual characteristics. In addition to species recorded during regular avian surveys, other project personnel recorded observations of migrant, uncommon, threatened, and endangered avian species that they encountered in the course of field activities pursuant to other Jobs.

Data bases were developed that recorded the locations, relative abundance, known breeding/migrant status, and vegetation communities where individual species were detected. Avian species richness and diversity were calculated for each census stop, transect, and the entire study area. Species richness was the total number of species recorded; species diversity was calculated using the Shannon Diversity Index (SDI). Kruskal-Wallis tests were

used to compare differences in species richness and diversity among transects.

Results

Common and scientific names of resident birds, their American Ornithologists' Union (AOU) species codes, and the total numbers and percent of detections recorded for each species on the 7 individual transects (45 census stops) and 10 qualitative census stops over the entire survey period are summarized in Table 6-1. Common and scientific names and AOU species codes of non-resident birds seen or heard before and during the survey period appear in Table 6-2. Census stops where threatened and endangered species, Illinois watch-list species, species of management concern in the midwest (Thompson 1993), and other species of interest appear in Figures 6-2 - 6-10. Appendix 6-A includes a tabulation (in avian ecological investigation format) of the transect legs, census stops, estimated breeding populations, and habitat preferences for each species recorded in the survey. Copies of data sheets for ranking the vegetation strata at census stops on 3 of the 6 transects appear in Appendix 6-B.

We recorded 112 species during the 1993 survey; 93 were resident, and 19 were non-resident species. Of the 19 non-resident species, 16 were considered migrants. Three non-resident species (hooded warbler, scarlet tanager, and rose-breasted grosbeak) would normally be considered residents, but were only seen before surveys began when transects were being marked in the field.

Six state endangered species were recorded in 1993 (great egret, snowy egret, little blue heron, black-crowned night heron, Mississippi kite and red-shouldered hawk). One federally endangered species (bald eagle), and 4 Illinois watch list species (broad-winged hawk, cerulean warbler, wood thrush, and hooded merganser) were also recorded. Bald eagles and yellow warblers were recorded recorded only at qualitative census points established near the lake margin. No rails or caprimulgids were recorded in surveys conducted in 1993.

Brown-headed cowbirds and red-winged blackbirds were the most abundant species recorded, each comprising 13% of total detections. Common grackles were the third most common bird accounting for 7.5% of detections. Other common species, each comprising at least 2% of total detections were: wood duck, mourning dove, yellow-billed cuckoo, eastern wood pewee, Acadian flycatcher, American

crow, tufted titmouse, carolina Wren, blue-gray gnatcatcher, common yellowthroat, dickcissel, northern cardinal, and indigo bunting.

Five resident and 15 migrant species documented by Evans and Klimstra (1982) were not recorded in the 1993 survey of Horeshoe Lake CA. Resident species not detected in 1993 included: yellow-crowned night heron (Nyctanassa violacea), common nighthawk, (Chordeies minor), Canada warbler (Wilsonia canadensis) and scarlet tanager (Piranga olivacea). Loggerhead shrike was not recorded during the course of the 1993 avian survey, but was recorded later in the summer during the plant community survey.

The estimated breeding population of scarlet tanagers reported by Evans and Klimstra (1982) was similar to that estimated for summer tanagers 1993. However, very few summer tanagers were recorded by Evans and Klimstra (1982). The two species respond aggressively toward each other (Ehrlich et al. 1988), so summer tanagers may have displaced scarlet tanagers from the area. Alternatively, summer tanagers may have been misidentified as scarlet tanagers by Evans and Klimstra (1982).

Eleven resident species recorded in the 1993 survey were not detected by Evans and Klimstra (1982). These included snowy egrets and black-crowned night herons, both state endangered species, and bald eagles, a federally endangered species. The other 8 species that were recorded in 1993 but not detected by Evans and Klimstra (1982) included: cattle egret, wild turkey, rock dove, eastern phoebe, house sparrow, dickcissel, house finch, and grasshopper sparrow.

Combining all 4 surveys, species richness varied between 47 and 74, and species diversity varied ranged from 2.99 to 3.71 on individual transects or the set of qualitative census stops (Tables 6-3 - 6-9). There were no differences in species diversity among transects (Kruskal-Wallis test, $H = 5.793$, $P > 0.05$), but species richness varied among transects (Kruskal-Wallis test, $H = 14.932$, $P < 0.05$). Species richness was lowest on transect 5 and greatest on the set of qualitative stops located on the lake margin.

Transect 5 differed from other transects in that it was located in a large forest tract that contained the lowest habitat diversity and no cropland. Although transect 5 had the lowest species richness, it had the greatest species evenness ($E = 0.89$) as the avifauna of this transect was not dominated by a small number species as on other transects. Over 30% of species detections on transects 1, 2, 3, and 6,

consisted of red-winged blackbirds, brown-headed cowbirds, and common grackles. These three species also comprised over 29% and 23% of the avian population for transects 4 and qualitative, respectively. Only 14% of the bird population on transect 5 consisted of these species.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON AVIAN COMMUNITIES

Studies on the effects of flooding on breeding birds is conspicuously absent in the literature. Hunter et al. (1987) studied effects of an abnormally long period of flooding on avian communities near the confluence of the Bill Williams and Colorado Rivers in Arizona. They documented a 75% loss of canopy trees that altered the avian habitat characteristics of the area. Similar to what was observed after summer flooding at Horseshoe Lake CA (see Job 3, Forest Community Description), foliage in middle and upper canopy layers was reduced. Distribution of foliage in the ground layer remained uniform after flooding, due to the appearance of emergent aquatic vegetation. Loss of trees for cavity and canopy nesting species resulted in a reduction in riparian bird species' densities; however, densities of marsh birds increased. Effects of a large flood on brown thrashers and rufous-sided towhees was investigated in the South Platte River floodplain of eastern Colorado by Knopf and Sedgwick (1987). Populations of these species did not decline during the flood year; however, a significant decline in densities occurred in the year after flooding.

Although studies of flood impacts on avian communities by Hunter et al. (1987) and Knopf and Sedgwick (1987) were conducted in regions distinctly different from Horseshoe Lake, they indicated some of the changes that might be expected after the 1993 flood. Reduction of foliage densities in the ground and subcanopy layers can be expected to alter the species composition and possibly overall density of the breeding bird community. Species that breed, nest, and/or feed in these forest layers can be expected to decline in subsequent breeding seasons. Knopf and Sedgwick (1987) found that ground feeding and nesting rufous-sided towhees and brown thrashers declined after flooding (Knopf and Sedgwick 1987). Species that require more open ground or lower foliage densities in the subcanopy would likely increase. If high water levels persist, then increases in marsh and other aquatic birds can also be expected.

Potential impacts of increased lake levels on resident bird species at Horseshoe Lake was evaluated by considering effects on key life history requisites that determine whether a species inhabits an area during the breeding season. We considered 4 life history requisites; 1) breeding site, 2) nesting site, 3) feeding site, and 4) diet. Although the relative importance of each life history requisite likely varies among species, each requisite was weighted equally since they are all essential for survival and reproduction.

For each resident species detected during the survey, we rated potential impacts of increased lake levels as having beneficial (+1), neutral (0) or detrimental (-1) effects on the 4 life requisites. Based on a review of literature summarizing life histories of these species (Bellrose 1980, Hancock and Kushlan 1984, Ehrlich et. al 1988, Johnsgard 1990, Herkert 1992, and Peterson and Crocoll 1992), we evaluated effects that flooding would have on preferred habitat conditions for each life requisite. For example, inundation of a forested area would negatively impact nest sites of ground-nesting Kentucky warblers, while flooding of a field/forest edge would positively affect the foraging mode and diet of great egrets. This method provided a general evaluation of potential effects of increased water levels on habitat conditions for the resident breeding bird community at Horeshoe Lake CA. We do not imply from this evaluation, however, that densities of certain species will increase, decline, or remain stable after the 1993 flood or with increases in lake level.

Of the 93 resident bird species, 10 (10.7%) benefitted in all categories and 6 (6.5%) benefitted in 3 of 4. In contrast, 40 (43%) species would be negatively impacted by flooding in all 4 kife requisites, and 8 (8.6%) were negatively affected in 3 of the 4 life history requisites. Of the 16 species that benefitted in 3 or more life requisites, 5 were endangered species (little blue heron, great egret, snowy egret, black-crowned night heron, and bald eagle) and 1 was an Illinois watch list species (hooded merganser). None of the 46 species negatively affected in 3 or more categories were endangered, however, 3 were Illinois watch list species (broad-winged hawk, cerulean warbler and wood thrush). Three species (dickcissel, Acadian flycatcher and grasshopper sparrow) are of management concern in the midwest (Thompson 1993).

Although flooding was determined to have a negative impact on at least 1 life requisite for 59 of 93 (63%) resident species, most were not limited in their distribution to habitats that occurred near the lake margin. One species (yellow-throated warbler) that highly associated

with the cypress/tupelo community in Horseshoe Lake was determined to benefit from flooding in all 4 life requisites.

The following is a brief description of life history requirements of endangered species in the area, and overall effects of increasing the lake level on threatened, endangered and watchlist species, and species of special management concern. Life history requirements were summarized from Ehrlich et. al (1988), Hancock and Kushlan (1984), Johnsgard (1990), Herkert (1992), and Peterson and Crocoll (1992).

Little Blue Heron.-- Breeding sites are located in marshes, ponds, lakes, and flooded grassland with isolated forest patches for nesting. Nest sites are about 2-40 feet above water in low trees or shrubs such as young stands of black willows (Salix nigra) cottonwoods Populus deltoides, cypress, (Taxodium spp., and buttonbush (Cephalanthus occidentalis). Little blue herons typically nest in association with other herons. They feed in shallow water on fish, amphibians, and invertebrates.

Little blue herons are not known to nest in the area, and use Horeshoe Lake CA primarily as a feeding site. Creation of suitable nesting sites could attract breeding birds to the area. Little blue herons were detected mostly at census stops located near the margins of bottomland forest south of Lake Creek (Figure 6-2). Only 4 of 13 census stops where this species was recorded were located near the lake margin. Higher lake levels could increase availablity of feeding sites and thereby attract more birds to the area.

Great Egret.-- Breeding sites are located in marshes, damp meadows, swamps, and river margins. Nests are located in trees, or bushes near emergent vegetation approximately 3-50 feet above ground. They nest either in colonies or solitarily. Great egrets forage alone or in groups in shallow water, consuming fish, small vertebrates, and aquatic invertebrates.

Like little blue herons, great egrets are not known to nest in the area and use Horeshoe Lake CA primarily as a feeding site. Great egrets were detected mostly at census stops located on the thumb and island portions of Horseshoe Lake CA (Figure 6-2). Elevated lake levels may expand existing feeding sites and create new feeding areas thus enhancing food resources and attract birds to the area.

Snowy Egret.--Breeding sites are located in marshes, lakes, ponds and other areas that border or are flooded by

water. Snow egrets are colonial, nesting in association with other herons. Nests are usually located less than 10 feet above ground in trees or shrubs. Snowy egrets feed in flocks on marshes and within flooded crop fields. Snowy egrets consume aquatic invertebrates, fish, and other small vertebrates.

Snowy egrets are not known to nest at Horeshoe Lake CA area. This species was seen on the area through 31 May 1993 and again in August 1993 after the flood. They were recorded at only 2 census stops located in forested bottomland south of Lake Creek (Figure 6-3). Snowy egrets were not previously recorded as summer residents of the area. Shallow water areas created by high spring water levels and the Mississippi River flood may have attracted these birds to the area.

Black-crowned night heron.-- Breeding sites are frequently located on the borders of shallow freshwater streams, marshes, swamps, ponds, and lakes. This species nests in small to large colonies, often among colonies of great blue herons and great egrets. Nest sites are in trees, shrubs or cattails (Typha spp.) 16-33 feet above ground. Black-crowned night herons are nocturnal or crepuscular and feed solitarily or in loose aggregations. Diet consists of fish, aquatic invertebrates, eggs and young of other herons.

Only one individual of this species was recorded at Horeshoe Lake CA. Similar to other herons and egrets this species was recorded in open bottomland south of Lake Creek (Figure 6-3). Black-crowned night herons are not known as residents or breeders at Horseshoe Lake CA. There were possibly more birds in the area that were not detected because of their crepuscular/nocturnal their foraging behavior. As with other herons, the increase in available foraging and potential breeding sites may attract more birds to Horeshoe Lake CA.

Mississippi kite.-- Breeding sites are located in mature, mixed bottomland forests that border marshes, cropland and other open areas. Nesting habitats are large forest tracts. Nests are located in the upper branches of tall trees, usually near streams, drainage ditches, or narrow roads. Diet consists of large insects, bats, amphibians, and occasionally small birds and carrion.

Breeding sites could be adversely impacted by flooding large tracts of forested bottomland, but this is an unlikely

event. Mississippi kites do not appear to be vulnerable to elevated lake levels. They were detected only in the forested bottomlands south of Lake Creek (Figure 6-4).

Red-shouldered Hawk.-- Breeding habitats include riparian forests, wooded swamps, river bottomlands, wooded marsh margins, and upland deciduous or mixed deciduous-coniferous forests. Large contiguous tracts of forest around 600 ac are apparently necessary to support breeding red-shouldered hawks. Nearly all nest sites are located near water, such as in swamps, rivers, or ponds. Nests are usually located 20-65 ft high in the crotch of a large tree. Size and shape of nest trees are apparently more important than tree species. Red-shouldered hawks forage under the forest canopy by perching. In more open areas, such as wetlands, crop fields, and open woodlands, they forage flying low and searching for prey. Diet consists mainly of small mammals, reptiles, amphibians, birds, and invertebrates.

Creation of more wooded swamps, moist hardwood forests and wooded marshy borders would increase availability of suitable for breeding habitat for red-shouldered hawks. Loss of prime nesting trees would clearly have a detrimental effect on red-shouldered hawks in the area. Given that permanently inundated areas will be concentrated around the lake margin, there is no threat to nesting habitat associated with raising the lake level. Red-shouldered hawks were recorded at only 2 census stops located near the lake margin (Figure 6-4). Except for one additional stop located on the thumb, the remaining detections of red-shouldered hawks occurred in forested bottomland south of Lake Creek.

Bald Eagle.-- Breeding sites are located in undisturbed areas near large rivers and lakes in Illinois. Nests are placed in the highest branches (30-60 ft.) of typically large, old conifers that provide an open view of the breeding area. Although bald eagles generally prefer live or dead fish of moderate to large sizes, their diet is more opportunistic than selective.

Large concentrations of eagles occur at Horseshoe Lake CA during winter. They are apparently attracted to the area by large populations of wintering waterfowl. Raising the lake level will not have any substantial impact on bald eagles. Bald eagles were observed at only 2 locations in summer 1993, near the dam, and at the north end of the island (Figure 6-5).

Other species.--Permanent standing water in forested areas would negatively impact nesting sites of cerulean warblers, Acadian flycatchers, and wood thrushes. These birds nest primarily in deciduous forests, where permanent water would kill potential nest trees. Foraging sites of the ground-feeding wood thrushes and leaf-gleaning cerulean warblers could also be negatively impacted by flooding. Individual birds nesting in areas near the lake may lose nesting and foraging sites. Numerous Wood Thrushes, Acadian Flycatchers and a few Cerulean Warblers were recorded at census stops near the lake margin (Figures 6-7 and 6-8).

Grasshopper sparrows and dickcissels detected near the lake margin (Figures 6-8 and 6-9) were seen or heard from within cropland and from the lake edge. If any cropland or herbaceous vegetation communities are inundated by water, these species will lose breeding and/or feeding sites. However, elevating the lake level will not likely extend into open cropland and herbaceous areas. The only concern is that spring flooding frequency and duration may increase with higher lake levels. This could have a negative impact on nesting and foraging sites of these grasshopper sparrows and dickcissels.

Prothonotary warblers , yellow-throated warblers, and hooded mergansers breed and forage in and near water. These species were recorded in areas likely to be impacted by increased lake levels (Figures 6-6, 6-9, and 6-10) and would likely benefit from increasing the pool level of Horseshoe Lake. Yellow-throated warblers showed an affinity for permanently flooded cypress/tupelo swamps at the lake margin. Since they already persist in such habitats, it is unlikely that they will be negatively impacted by raising the lake level.

Overall, minimal negative impacts of raising the lake level are anticipated for avian species at Horseshoe Lake. No species that would be negatively impacted by raising the lake level was restricted to habitats that would be inundated. Consequently no species are expected to be extirpated from the area as a result of rasising the lake level. Aquatic birds such as herons, egrets, and waterfowl, some of which are threatened, endangered, or watch-list species should benefit from expansion of shallowly flooded and shoreline habitats that might be created near the lake margin.

Rails and bitterns were conspicuously absent from the Horseshoe Lake avifauna, although apparently suitable habitats were present in isolated areas. These species require non-wooded wetlands with robust emergent vegetation. Numerous emergent wetland basins were present throughout the

area (see Job 2, Vegetation Mapping) that could be managed for these and other aquatic species if they were not annually tilled and if surface water could be controlled or retained on such areas. There is opportunity to manage shallow emergent wetlands to benefit wading and other aquatic birds at Horseshoe Lake CA.

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TABLE 6-1. Total numbers and percent species composition of resident bird species detected on individual transects and qualitative census stops at Horseshoe Lake Conservation Area during May and June 1993.

Common name, Genus species, AOU code	Transect						Qualitative	No. Detections	
	1	2	3	4	5	6		Total	%
Canada goose, *Branta canadensis*, (CAGO)	1	0	0	0	0	1	77	79	0.78
Mallard, *Anas platyrhynchos*, (MALL)	0	0	9	4	0	1	0	14	0.13
Wood duck, *Aix sponsa*, (WODU)	53	28	62	23	3	17	54	240	2.38
Blue-winged teal, *Anas discors*, (BWTE)	0	0	0	0	0	1	0	1	0.01
Hooded merganser, *Lophodytes cucullatus*, (HOME)	0	8	0	0	0	1	0	9	0.08
Great blue heron, *Ardea herodias*, (GBLH)	5	10	82	24	5	11	19	156	1.54
Little blue heron, *Egretta caerulea*, (LBHE)*E*	0	2	19	2	0	1	9	33	0.32
Great egret, *Casmerodius albus*, (GREG)*E*	7	2	1	0	0	1	2	13	0.12
Snowy egret, *Egretta thula*, (SNEG)*E*	0	5	11	0	0	0	0	11	0.10
Cattle egret, *Bubulcus ibis*, (CAEG)	0	9	8	6	0	26	1	50	0.49
Black-crowned night heron, *Nycticorax nycticorax* (BCNH)*E*	0	0	1	0	0	0	0	1	0.01
Green-backed heron, *Butorides striatus*,(GRHE)	0	6	8	5	0	2	6	27	0.26
Killdeer, *Charadrius vociferus*, (KILL)	5	1	1	0	0	12	7	26	0.25
Wild turkey, *Meleagris gallopavo*, (WITU)	0	0	1	0	0	0	0	1	0.01
Northern bobwhite, *Colinus virginianus*,(NOBO)	6	5	0	1	0	5	2	19	0.18
Mississippi kite, *Ictinia mississippienis*,(MIKI)*E*	0	0	6	4	0	0	0	10	0.09
Red-tailed hawk, *Buteo jamaicensis*, (RTHA)	2	4	3	3	3	1	2	18	0.17
Red-shouldered hawk, *Buteo lineatus*, (RSHA)*E*	1	0	9	1	1	0	4	16	0.15
Broad-winged hawk, *Buteo platypterus*, (BWHA)	1	0	0	0	0	0	0	1	0.01
Bald eagle, *Haliaeetus leucocephalus*, (BAEA)*E*	1	0	0	0	0	0	4	5	0.05
Turkey vulture, *Cathartes aura*,(TUVU)	0	0	1	0	0	0	0	1	0.01
American kestrel,*Falco sparverius*, (AMKE)	0	0	0	0	0	1	0	1	0.01
Screech owl, *Otus asio*, (SCOW)	1	0	0	0	0	0	0	1	0.01
Great horned owl, *Bubo virginianus*, (GHOW)	1	1	0	0	0	0	0	2	0.03
Barred owl, *Strix varia*, (BAOW)	1	5	1	1	2	0	0	10	0.09
Rock dove, *Columba livia*, (RODO)	2	0	0	0	0	0	0	2	0.02
Mourning dove, *Zenaida macroura*, (MODO)	67	32	18	20	1	36	30	204	2.02
Yellow-billed cuckoo, *Coccyzus americanus*, (YBCU)	29	30	28	29	44	28	15	203	1.93

TABLE 6-1. Continued.

Common name, Genus species, AOU code	Transect 1	2	3	4	5	6	Qualitative	No. Detections Total	%
Ruby-throated hummingbird, *Archilochus colubris*, (RTHU)	11	7	8	8	10	15	10	69	0.68
Belted kingfisher, *Megaceryle alcyon*, (BEKI)	2	1	1	9	0	2	1	16	0.15
Red-headed woodpecker, *Melanerpes erythrocephalus*, (RHWO)	27	17	28	22	19	27	13	153	1.52
Pileated woodpecker, *Dryocopus pileatus*, (PIWO)	12	6	6	7	11	9	3	54	0.53
Northern flicker, *Colaptes auratus*, (NOFL)	6	9	17	12	6	13	8	71	0.70
Red-bellied woodpecker, *Melanerpes carolinus*,(RBWO)	18	14	26	22	32	21	22	155	1.54
Downy woodpecker, *Picoides pubescens*, (DOWO)	9	9	29	18	31	9	10	115	1.14
Hairy woodpecker, *Picoides villosus*, (HAWO)	2	4	15	10	10	5	5	51	0.51
Eastern kingbird, *Tyrannus tyrannus*, (EAKI)	14	5	3	4	0	6	13	42	0.46
Great crested flycatcher, *Myiarchus crinitus*, (GCFL)	28	17	17	14	24	30	16	146	1.47
Eastern phoebe, *Sayornis phoebe*, (EAPH)	0	0	0	0	2	0	1	3	0.03
Eastern wood pewee, *Contopus virens*, (EWPE)	34	27	32	28	43	33	23	220	2.19
Acadian flycatcher, *Empidonax virescens*, (ACFL)	22	33	44	39	54	31	17	240	2.38
Horned lark, *Eremophila alpestris*, (HOLA)	20	19	1	0	0	27	5	72	0.72
Purple martin, *Progne subis*, (PUMA)	1	3	5	0	0	5	24	38	0.38
Barn swallow, *Hirundo rustica*, (BASW)	7	6	7	5	10	8	4	47	0.47
Tree swallow, *Iridoprocne bicolor*, (TRSE)	2	0	1	0	0	0	4	7	0.07
Rough-winged swallow, *Stelgidopteryx ruficollis*, (RWSW)	10	0	4	4	0	0	12	30	0.30
Chimney swift, *Chaetura pelagica*, (CHSW)	25	19	9	15	5	23	27	123	1.22
American crow, *Corvus brachyrhynchos*, (AMCR)	37	49	48	19	33	27	23	236	2.34
Fish crow, *Corvus ossifragus*,(FICR)	0	7	9	3	3	1	1	24	0.24
Blue jay, *Cyanocitta cristata*, (BLJA)	5	6	8	11	14	3	3	50	0.50
Carolina chickadee, *Parus carolinensis*, (CACH)	9	20	32	14	35	29	15	154	1.53
Tufted titmouse, *Parus bicolor*, (TUTI)	37	33	29	22	51	44	21	237	2.35
White-breasted nuthatch, *Sitta carolinensis*, (WBNU)	6	7	13	10	24	17	7	84	0.83
Carolina wren, *Thryothorus ludovicianus*, (CAWR)	25	29	30	32	48	37	23	224	2.23
Blue-gray gnatcatcher, *Polioptila caerulea*, (BGGN)	43	35	31	17	41	41	19	227	2.23

TABLE 6-1. Continued.

Common name, Genus species, AOU code	Transect 1	2	3	4	5	6	Qualitative	No. Detections Total	%
Brown thrasher, *Toxostoma rufum*, (BRTH)	2	2	0	6	0	6	4	20	0.02
Gray catbird, *Dumetella carolinensis*, (GRCA)	1	2	0	0	0	0	0	3	0.03
Northern mockingbird, *Mimus polyglottos*, (NOMO)	3	2	0	3	0	3	2	13	0.13
Eastern bluebird, *Sialia sialis*, (EABL)	10	4	1	1	0	7	7	30	0.30
American robin, *Turdus migratorius*, (AMRO)	53	21	0	6	0	21	29	130	1.29
Wood thrush, *Hylocichla mustelina*, (WOTH)	15	18	9	19	20	32	14	127	1.26
Red-eyed vireo, *Vireo olivaceus*, (REVI)	3	3	7	9	18	1	2	43	0.43
Warbling vireo, *Vireo gilvus*, (WAVI)	35	26	0	0	0	22	18	101	1.00
Yellow-throated vireo, *Vireo flavifrons*, (YTV)	10	6	18	7	19	5	5	70	0.69
White-eyed vireo, *Vireo griseus*, (WEVI)	25	25	2	6	0	8	4	70	0.07
Northern parula warbler, *Parula americana*, (NPWA)	14	6	21	26	19	10	9	105	1.04
Yellow warbler, *Dendroica petechia*, (YEWA)	0	0	0	0	0	0	3	3	0.03
Yellow-throated warbler, *Dendroica dominica*, (YTWA)	5	1	2	6	0	5	19	38	0.38
Prothonotary warbler, *Protonotaria citrea*, (PRWA)	22	12	22	28	21	20	26	151	1.50
Cerulean warbler, *Dendroica cerulea*, (CERW)	0	0	0	0	6	0	2	8	0.08
American redstart, *Setophaga ruticilla*, (AMRE	0	0	1	1	0	0	0	2	0.02
Kentucky warbler, *Oporornis formosus*, (KEWA)	0	1	9	2	12	5	0	29	0.29
Common yellowthroat, *Geothlypis trichas*, (COYE)	42	28	38	31	12	26	21	198	1.98
Yellow-breasted chat, *Icteria virens*, (YBCH)	3	8	1	2	0	4	4	22	0.22
Red-winged blackbird, *Agelaius phoeniceus*, (RWBL)	424	214	239	138	5	213	87	1320	13.10
Brown-headed cowbird, *Molothrus ater*, (BHCO)	305	194	144	137	99	364	84	1327	13.20
Common grackle, *Quiscalus quiscula*, (COGR)	173	147	138	65	29	102	101	755	7.50
Eastern meadowlark, *Sturnella magna*, (EAME)	47	23	15	6	0	27	7	125	1.24
European starling, *Sturnus vulgaris*, (EUST)	0	4	0	11	0	12	2	29	0.29
Orchard oriole, *Icterus spurius*, (OROR)	14	4	0	1	0	8	6	33	0.33
Northern oriole, *Icterus galbula*, (NOOR)	10	18	3	3	2	3	0	39	0.39
Summer tanager, *Piranga rubra*, (SUTA)	1	3	5	5	18	3	4	39	0.39
House sparrow, *Passer domesticus*, (HOSP)	19	1	0	0	0	6	3	29	0.29
Dickcissel, *Spiza americana*, (DICK)	48	48	21	12	1	84	9	223	2.22
Northern cardinal, *Cardinalis cardinalis*, (NOCA)	42	61	33	37	36	39	41	289	2.87

TABLE 6-1. Continued.

Common name, Genus species, AOU code	Transect 1	2	3	4	5	6	Qualitative	No. Detections Total	%
House finch, *Carpodacus mexicanus*, (HOFI)	4	1	0	1	0	0	4	10	0.10
American goldfinch, *Carduelis tristis*, (AMGO)	17	33	38	30	13	20	21	172	1.71
Indigo bunting, *Passerina cyanea*, (INBU)	31	50	39	59	37	33	35	284	2.82
Rufous-sided towhee, *Pipilo erythrophthalmus*, (RSTO)	1	13	0	2	2	4	1	23	0.23
Chipping sparrow, *Spizella passerina*, (CHSP)	8	0	0	0	0	0	0	8	0.08
Field sparrow, *Spizella pusilla*, (FISP)	5	21	21	6	0	23	2	78	0.78
Song sparrow, *Melospiza melodia*, (SOSP)	33	12	13	14	1	3	3	79	0.78
Grasshopper sparrow, *Ammodramus savannarum*, (GRSP)	0	0	0	0	0	3	1	4	0.04

TABLE 6-2. Non-resident species seen or heard at Horseshoe Lake Conservation Area, May-July 1993.

Common name, Genus species, AOU code
Olive-sided flycatcher, *Nuttallornis borealis*, (OSFL)
Yellow-bellied flycatcher, *Empidonax flaviventris*, (YBFL)
Least flycatcher, *Empidonax minimus*, (LEFL)
Willow flycatcher, *Empidonax traillii*, WIFL)
Swainson's thrush, *Catharus ustulatus* (SWTH)
Cedar waxwing, *Bombycilla cedrorum*, (CEWA)
Philadelphia vireo, *Vireo philadelphicus*, (PHVI)
Bell's vireo, *Vireo bellii*, (BEVI)
Black-throated green warbler, *Dendroica virens*, (BTGW)
Magnolia warbler, *Dendroica magnolia*, (MAWA)
Yellow-rumped warbler, *Dendroica coronata*, (YRWA)
Chestnut-sided warbler, *Dendroica pensylvanica*, (CSWA)
Blackburnian warbler, *Dendroica fusca*, (BLWA)
Blue-winged warbler, *Vermivora pinus*, (BWWA)
Hooded warbler, *Wilsonia citrina*, (HOWA)
Nashville warbler, *Vermivora ruficapilla*, (NAWA)
Mourning warbler, *Oporornis philadelphia*, (MOWA)
Scarlet tanager, *Piranga olivacea*, (SCTA)
Rose-breasted grosbeak, *Pheucticus ludovicianus*, (RBGR)

TABLE 6-3. Community type, species richness, and diversity recorded at census stops on transect 1 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Census Stops	Community Type [a]	Species Richness	Species Diversity [b]
1	DL	38	2.69
1.5	CR		
2	CR	38	2.77
2.5	CR		
3	DL	46	2.93
3.5	CR		
4	DL	40	3.10
4.5	CR		
5	CR	41	2.78
5.5	CR		
6	F/SF/CR	40	3.03
6.5	CR		
7	F/SW	45	3.42
7.5	F/SW		
8	CR	32	2.77
Total transect		73	2.99

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW);
[b]Shannon Diversity Index

TABLE 6-4. Community type, species richness, and diversity recorded at census stops on transect 2 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Census Stops	Community Type [a]	Species Richness	Species Diversity [b]
9	CR/DL	53	3.31
9.5	CR		
10	F	42	3.45
10.5	CR/F		
11	CR	46	3.16
11.5	CR		
12	F/OW	39	3.22
12.5	F		
13	F/SW	40	3.17
13.5	CR		
14	CR	39	3.00
14.5	CR		
15	CR	41	2.71
15.5	CR/FC/F		
16	CR/F/OW	34	2.98
Total transect		71	3.43

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW).
[b]Shannon Diversity index

TABLE 6-5. Community type, species richness, and diversity recorded at census stops on transect 3 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Census Stop	Community Type [a]	Species Richness	Species Diversity [b]
17	CR/F	46	3.50
17.5	CR/F		
18	CR	42	2.93
18.5	CR		
19	F	46	2.94
19.5	FC/F		
20	CR/F	40	3.25
20.5	FF/F		
21	F	35	3.15
21.5	FF/F		
22	CR/F	41	3.36
22.5	F/SW		
23	CR/F	41	3.10
23.5	F/SW		
Total transect		68	3.47

[a]Cropland (CR); Flooded Crop (FC); Forest (F);Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW).
[b]Shannon Diversity Index

TABLE 6-6. Community type, species richness, and diversity recorded at census stops on transect 4 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Census Stop	Community Type [a]	Species Richness	Species Diversity [b]
24	CR	40	3.05
24.5	CR/FC/F		
25	CR/F	47	3.50
25.5	SW		
26	F	45	3.13
26.5	CR/F		
27	CR/F	45	3.43
27.5	FF/SW		
28	SW	38	3.29
28.5	SW		
29	FF/SW	45	3.54
29	F/FF		
30	F	31	2.98
30.5	CR/F		
Total transect		68	3.47

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW).
[b]Shannon Diversity Index

TABLE 6-7. Community type, species richness, and diversity recorded at census stops on transect 5 during avian surveys conducted Horseshoe Lake Conservation Area during summer 1993.

Census Stop	Community Type [a]	Species Richness	Species Diversity [b]
31	F	35	3.35
31.5	F		
32	F	32	3.18
32.5	F/FF		
33	F/FF	27	2.97
33.5	F		
34	F	28	3.17
34.5	F/FF		
35	F/SW	31	3.19
35.5	F/SW		
36	F/SW	35	3.32
36.5	F		
37	F	21	2.61
Total transect		47	3.44

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Warer (OW).
[b]Shannon Diversity Index

TABLE 6-8. Community type, species richness, and diversity recorded at census stops on transect 6 during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Census Stop	Community Type [a]	Species Richness	Species Diversity [b]
38	SF	44	3.08
38.5	CR/F		
39	F	49	2.88
39.5	CR		
40	CR/F	43	3.46
40.5	CR		
41	CR	42	2.36
41.5	CR		
42	CR/F	40	2.86
42.5	F		
43	F/SW	36	3.39
43.5	F/SW		
44	F/SW	38	3.47
44.5	F/SF		
45	SF/SW	28	3.14
Total transect		72	3.34

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF); Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW).
[b]Shannon Diversity Index

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TABLE 6-9. Community type, species richness, and diversity recorded at qualitative census stops during avian surveys conducted at Horseshoe Lake Conservation Area during summer 1993.

Qualitative Census Stop	Community Type [a]	Species Rchness	Species Diversity [b]
46	SF/SW	35	3.28
47	OW	49	3.34
48	CR/SW	46	3.28
49	CR/SW	35	3.16
50	CR/SW	42	3.32
51	OW/SW	35	3.24
52	F/OW/DL	36	3.31
53	CR/F/SW	32	3.25
54	OW/SW/DL	35	2.12
Total qualitative		74	3.71

[a]Cropland (CR); Flooded Crop (FC); Forest (F); Flooded Forest (FF): Swamp (SW); Successional Field (SF); Developed Land (DL); Open Water (OW).
[b]Shannon Diversity Index

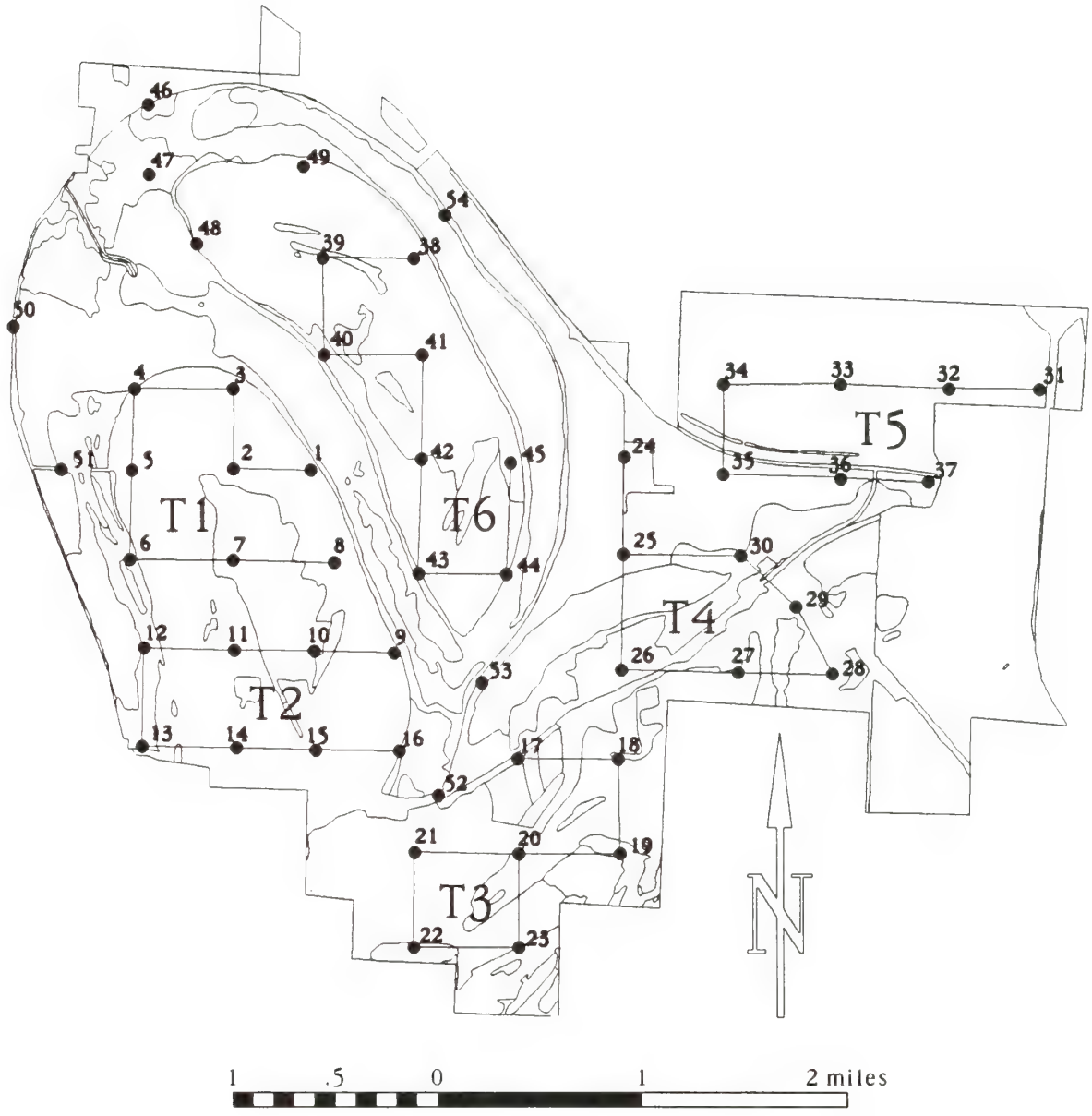
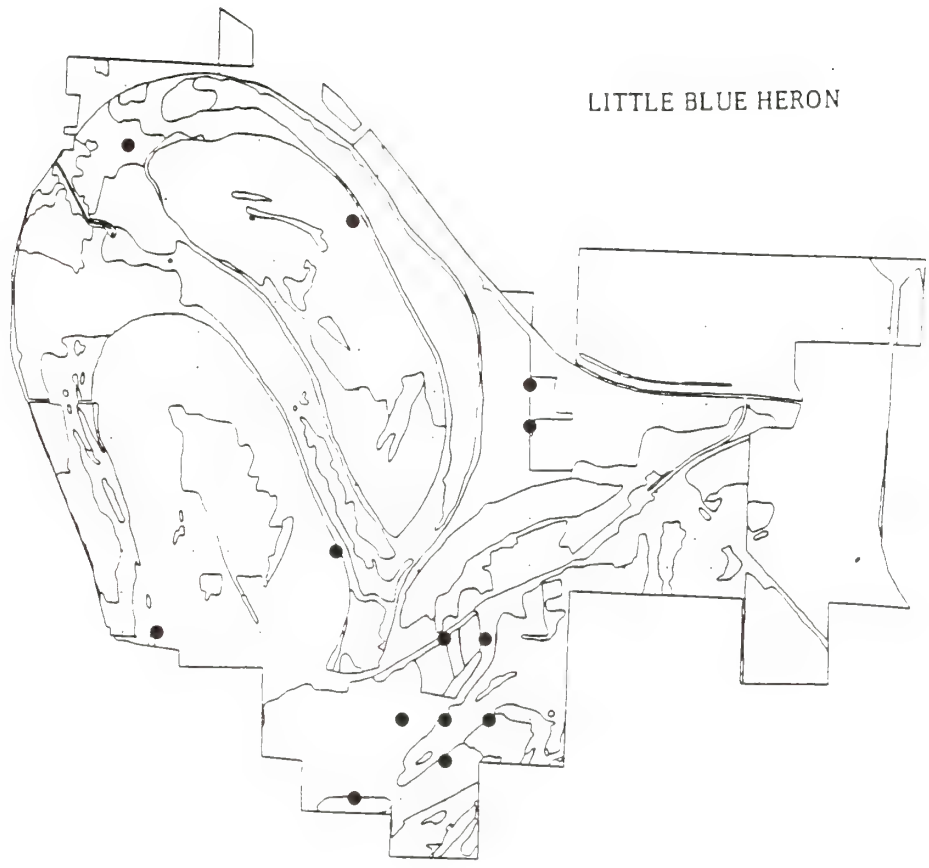


Figure 6-1. Locations of 45 census stops on 6 transects (T1-T6), and 10 qualitative census stops (not located on transects) were detections of avian species were recorded during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

Figure 6-2. Census stops where little blue herons and great egrets were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.


LITTLE BLUE HERON

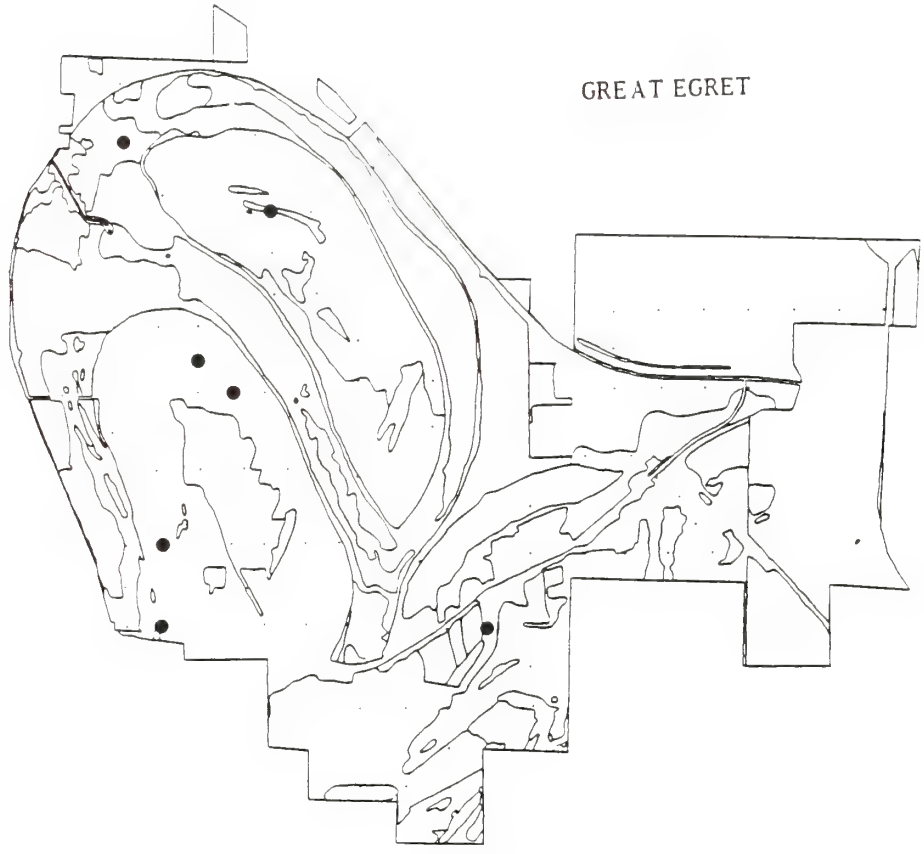
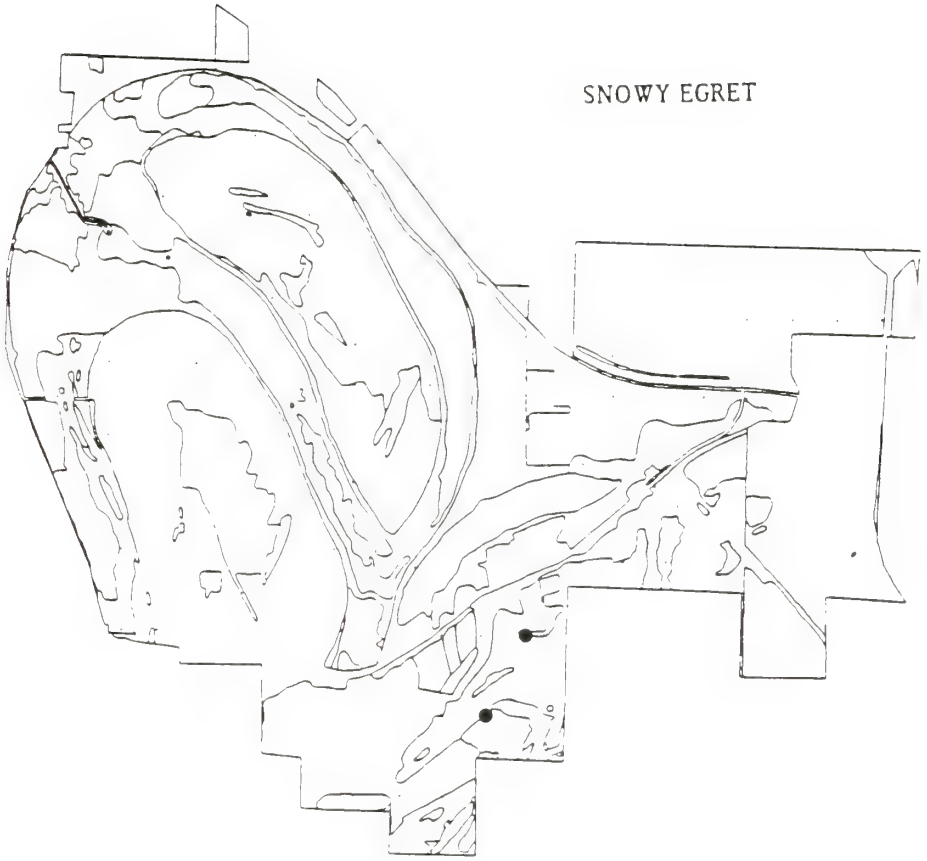

GREAT EGRET

Figure 6-3. Census stops where snowy egrets and black-crowned night herons were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

SNOWY EGRET



BLACK-CROWNED NIGHT HERON

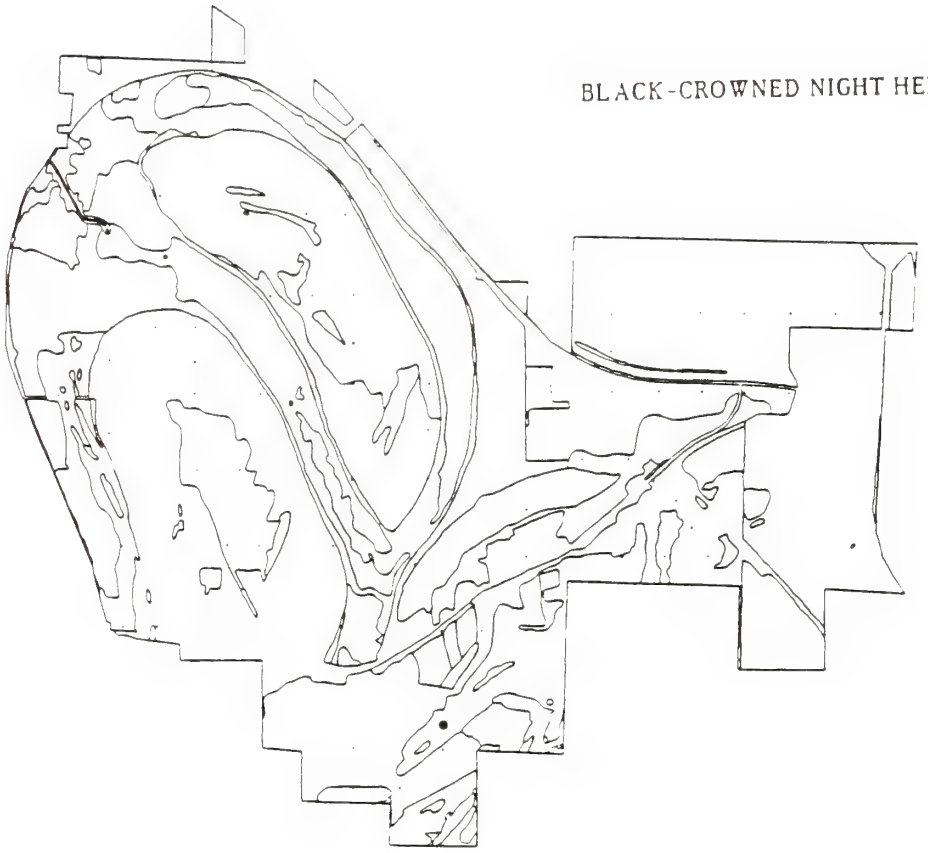
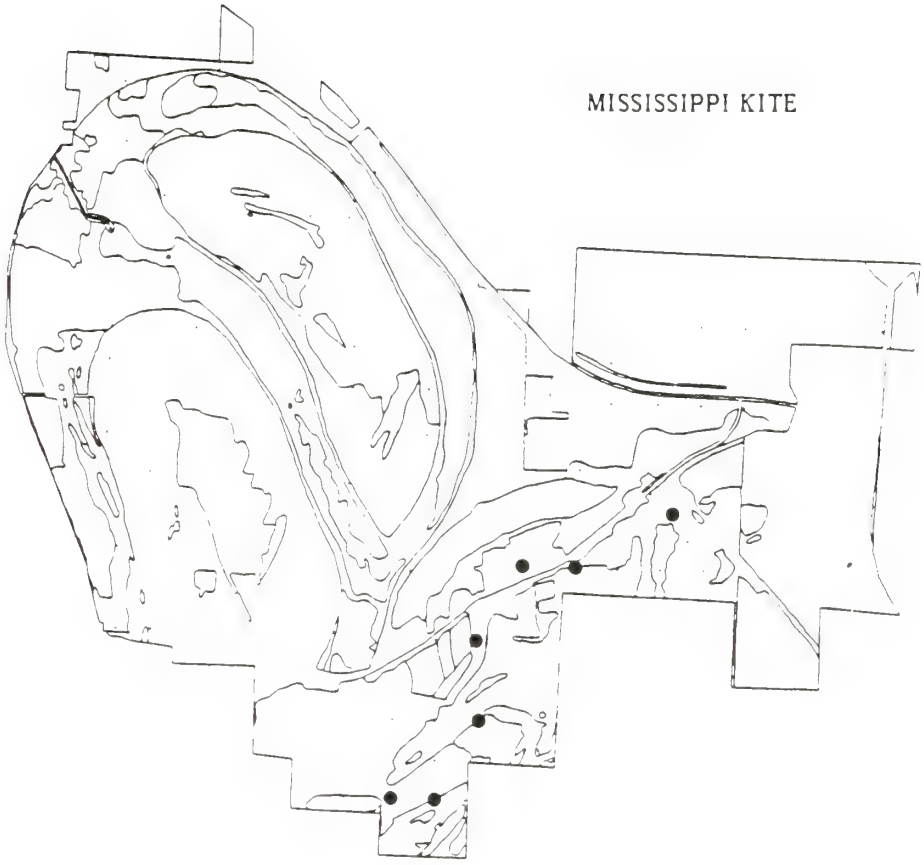


Figure 6-4. Census stops where Mississippi kites and red-shouldered hawks were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

MISSISSIPPI KITE



RED-SHOULDERED HAWK

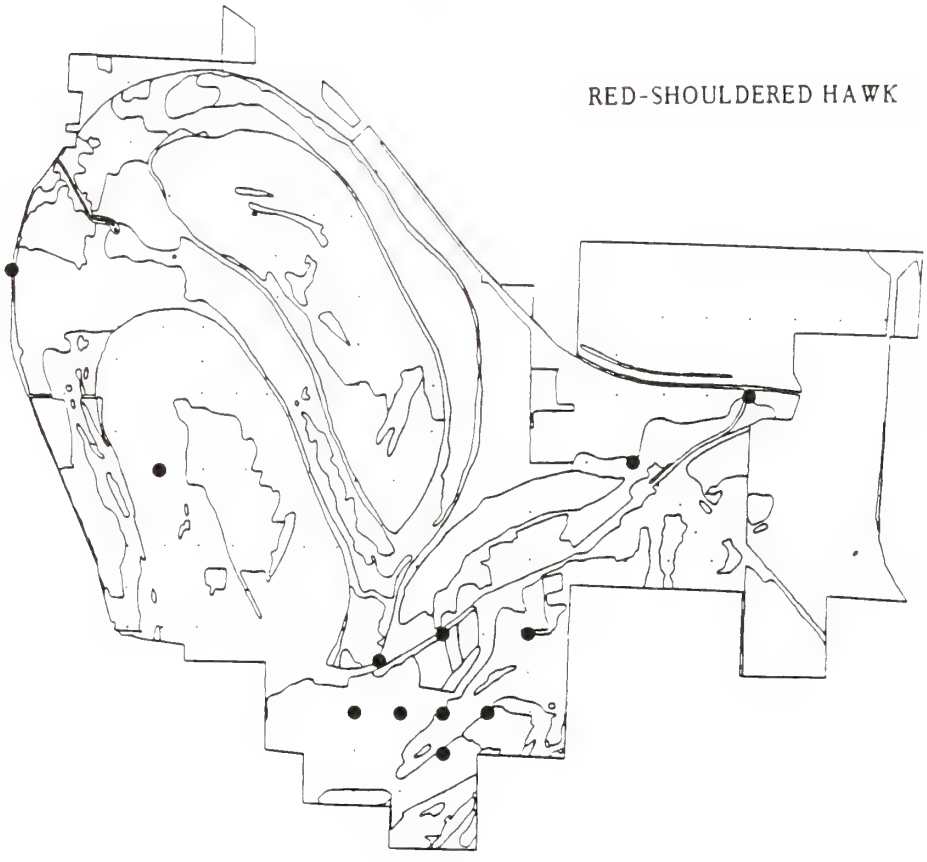
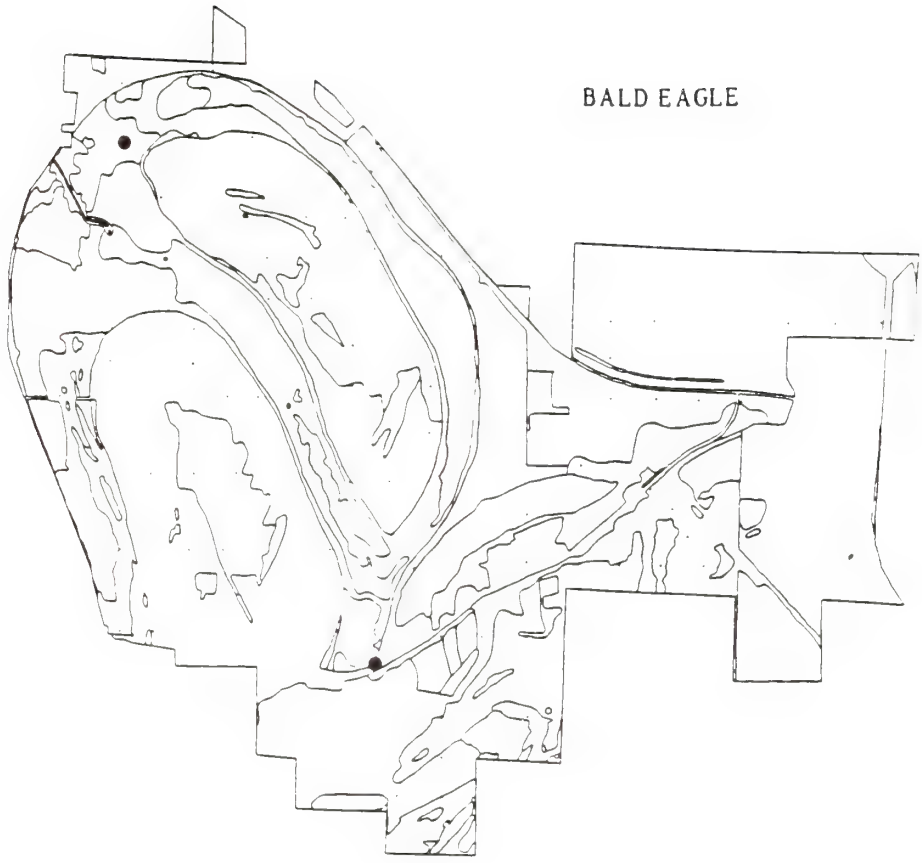


Figure 6-5. Census stops where bald eagles and loggerhead shrikes were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.


BALD EAGLE

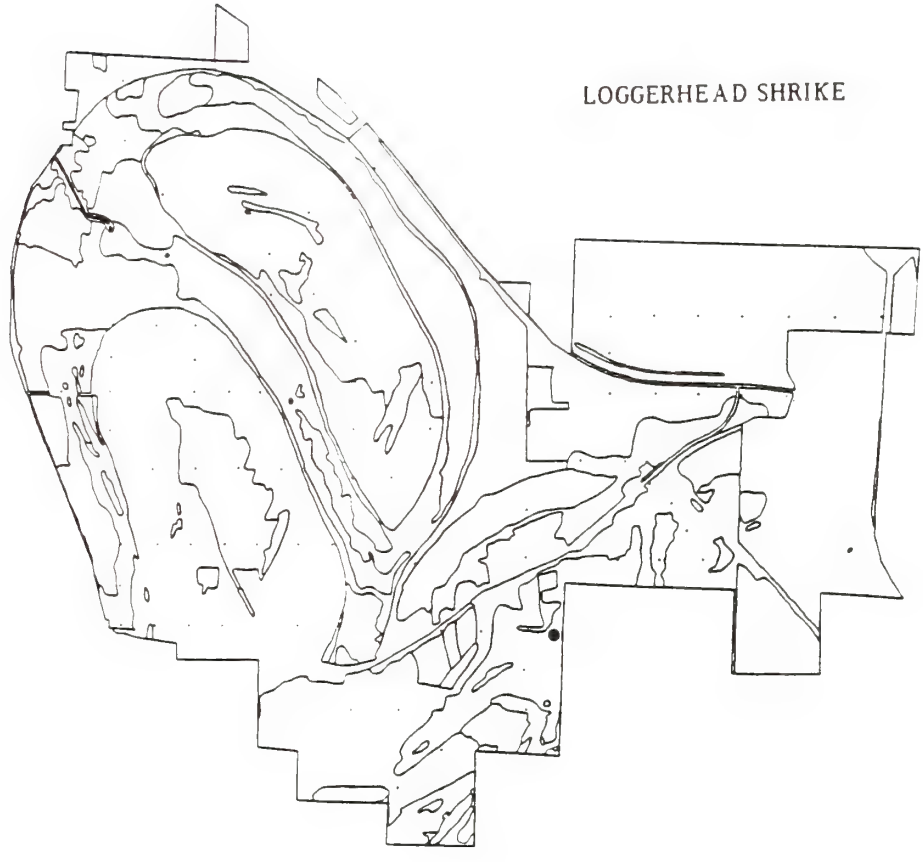
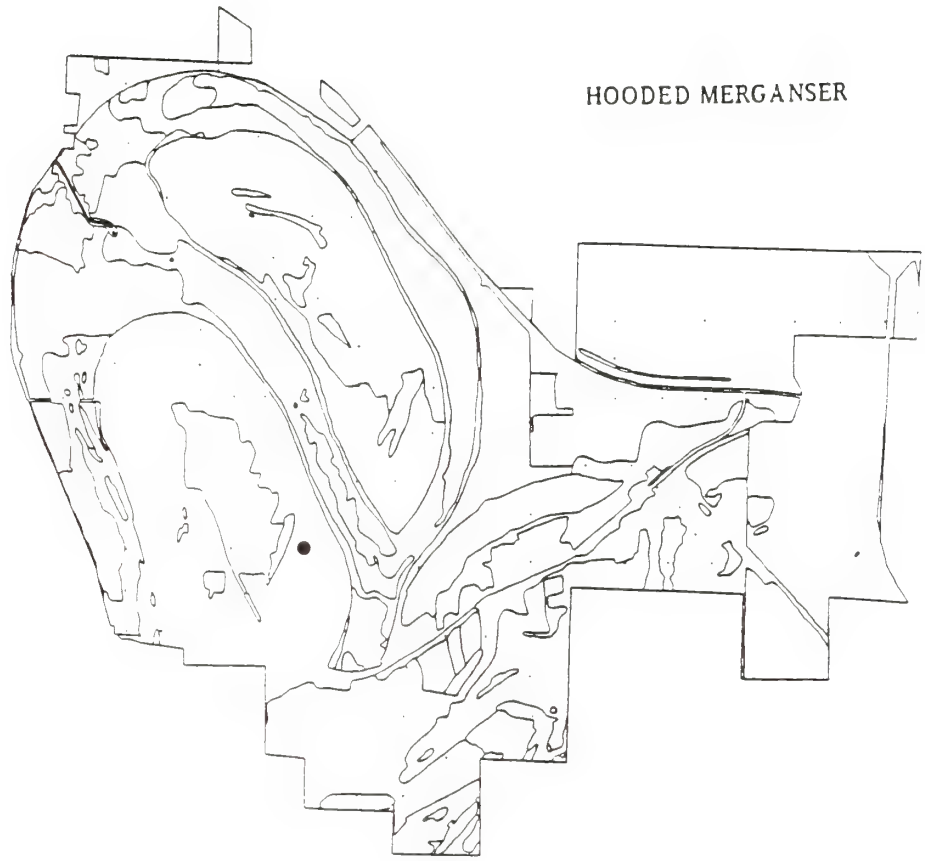

LOGGERHEAD SHRIKE

Figure 6-6. Census stops where hooded mergansers and broad-winged hawks were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.


HOODED MERGANSER

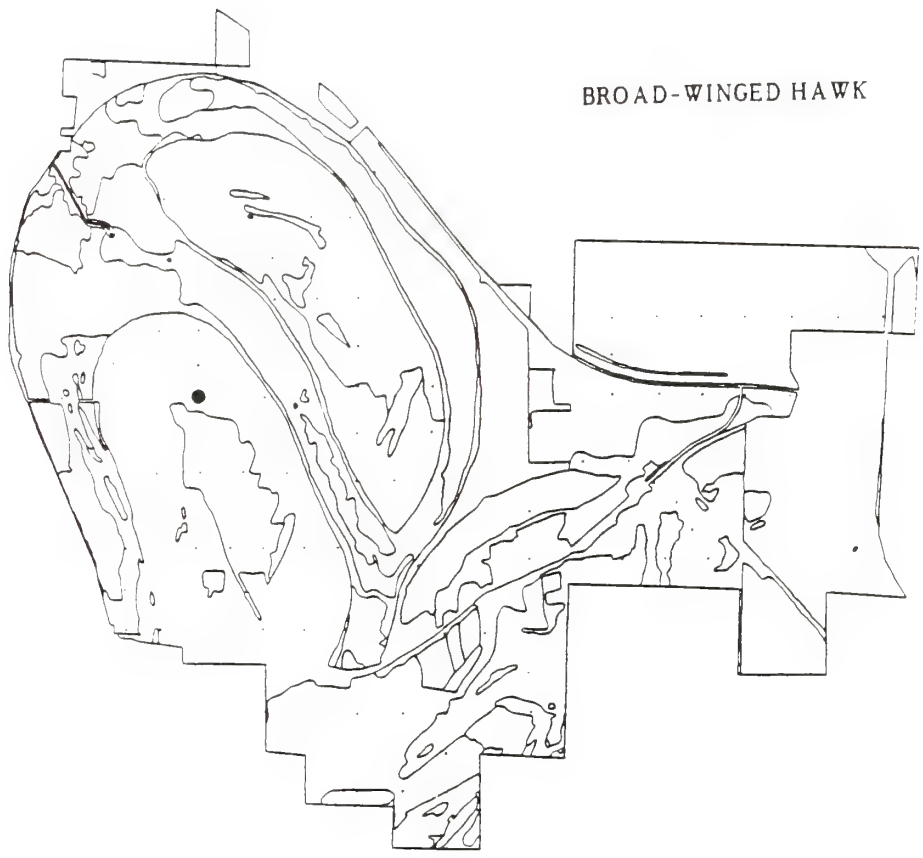
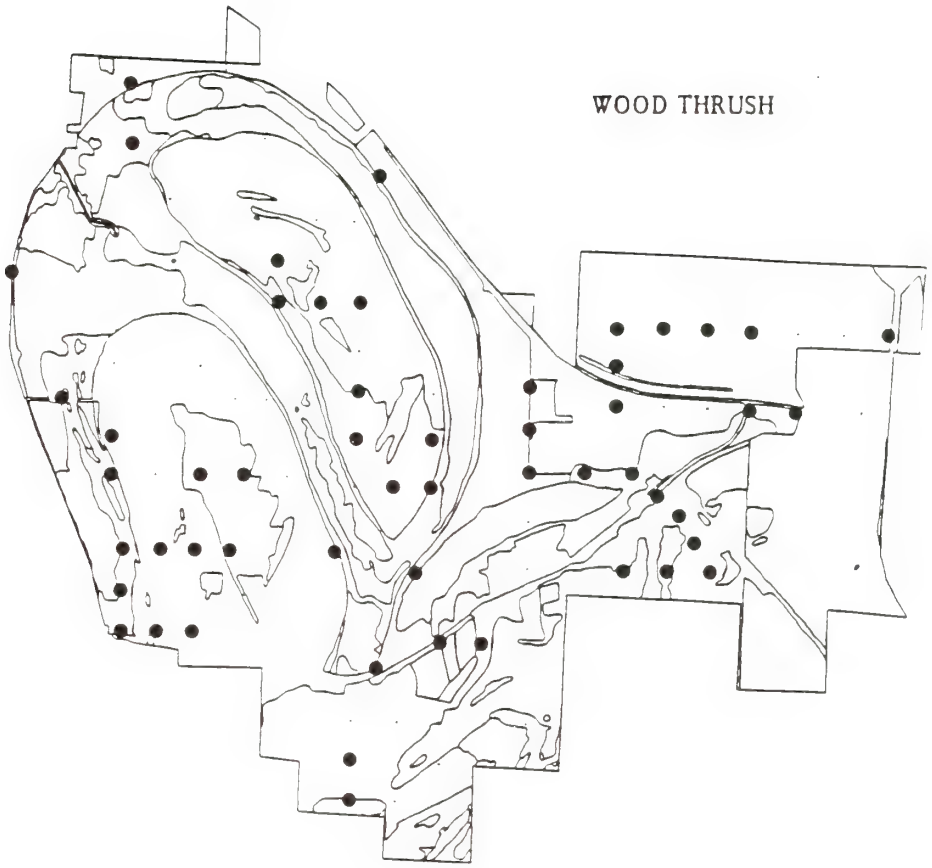

BROAD-WINGED HAWK

Figure 6-7. Census stops where wood thrushes and cerulean warblers were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.


WOOD THRUSH

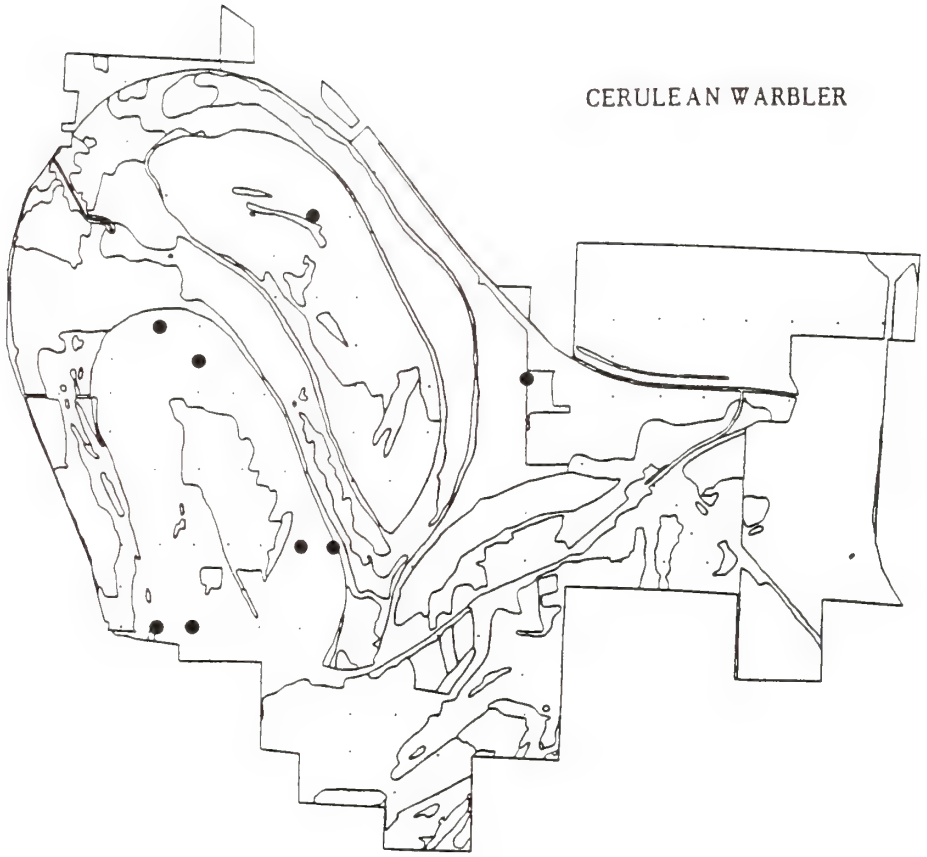
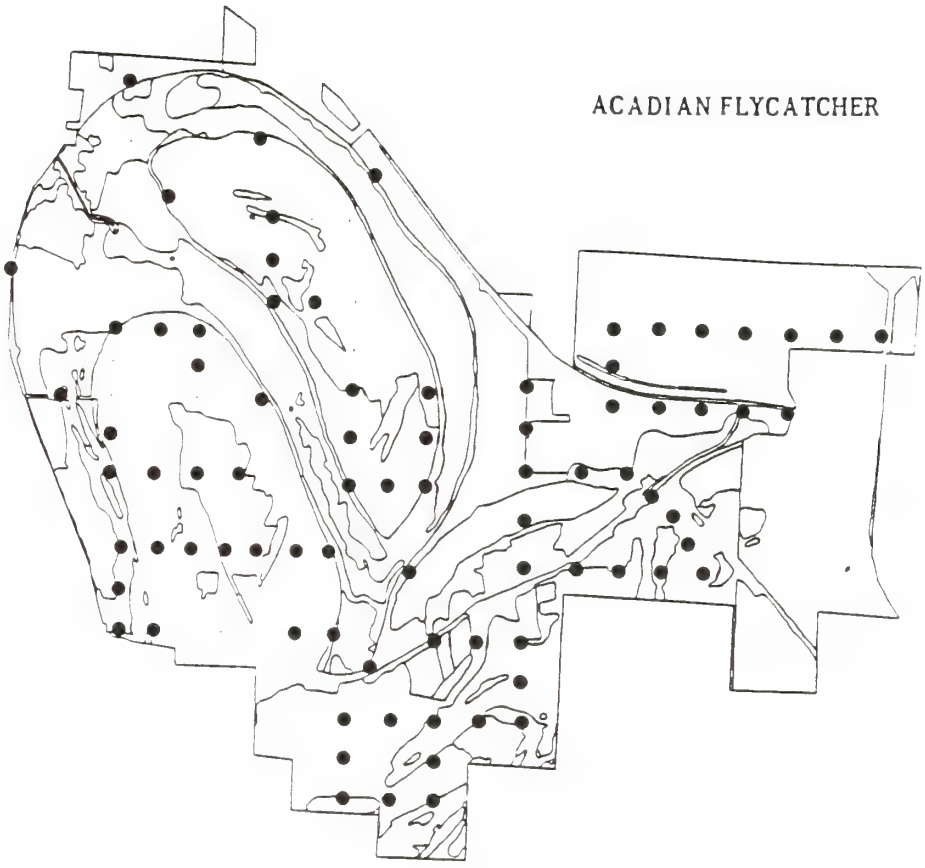

CERULEAN WARBLER

Figure 6-8. Census stops where Acadian flycatchers and dickcissels were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

ACADIAN FLYCATCHER



DICKCISSEL

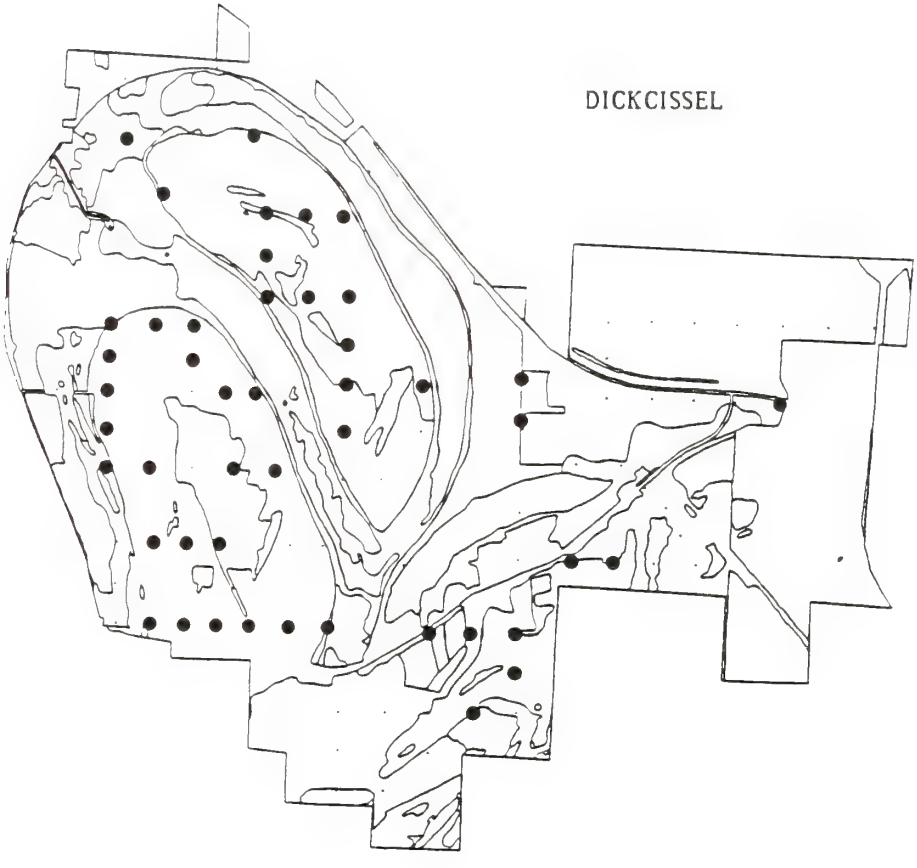
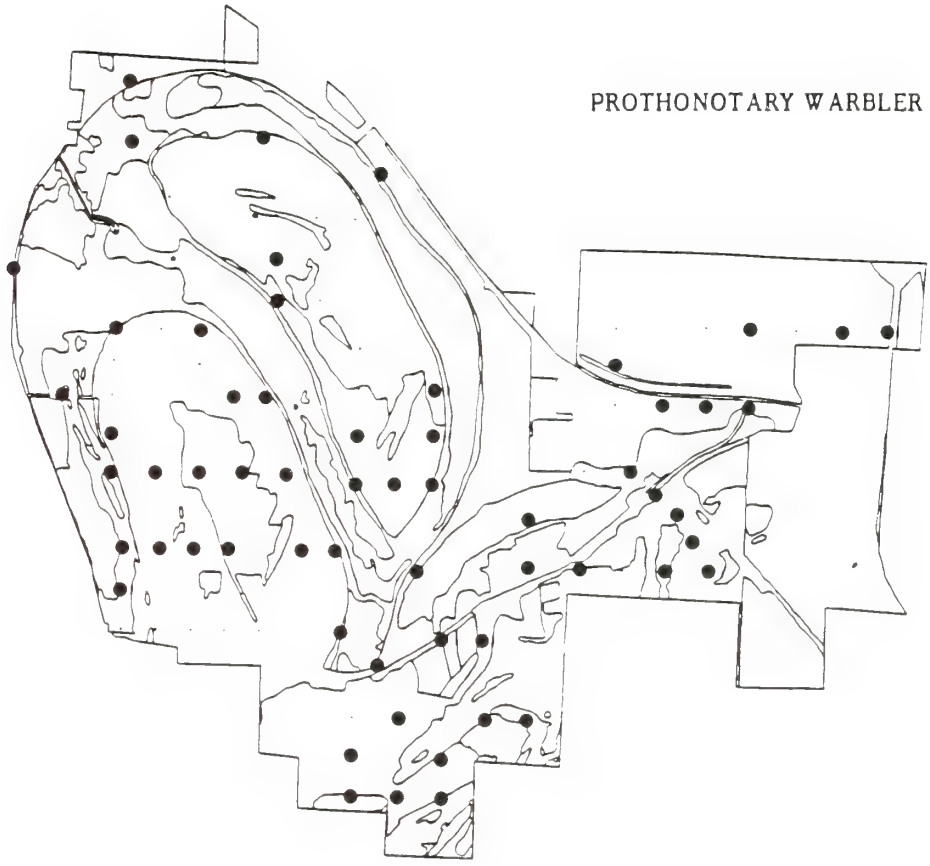


Figure 6-9. Census stops where prothonotary warblers and grasshopper sparrows were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

PROTHONOTARY WARBLER



GRASSHOPPER SPARROW

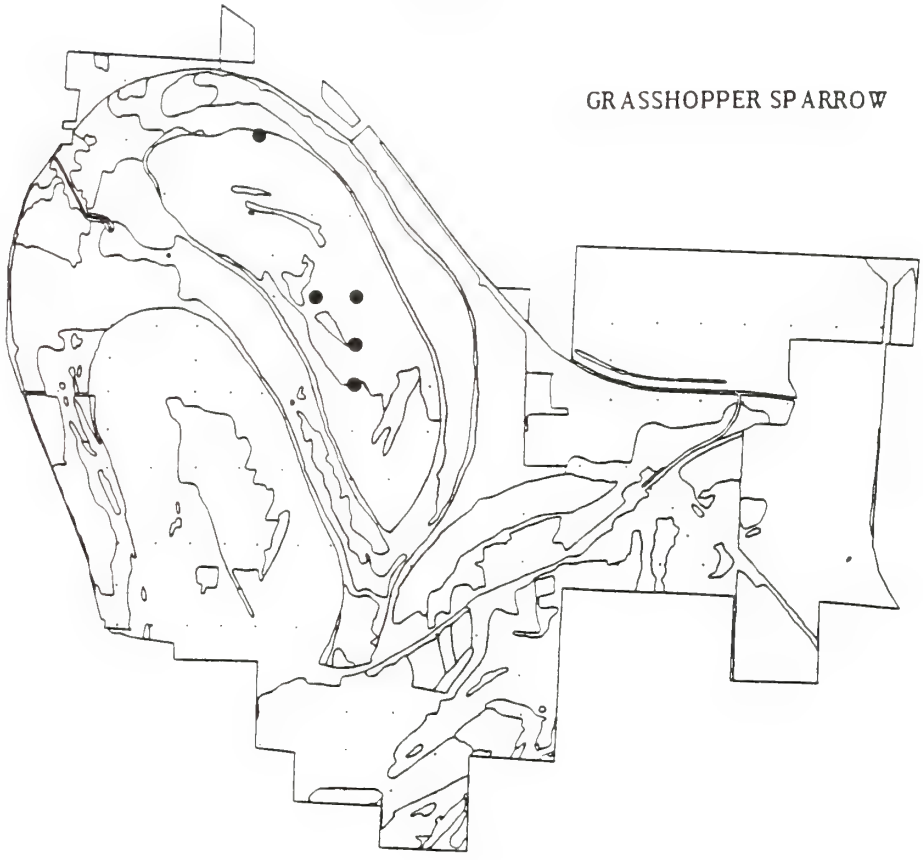
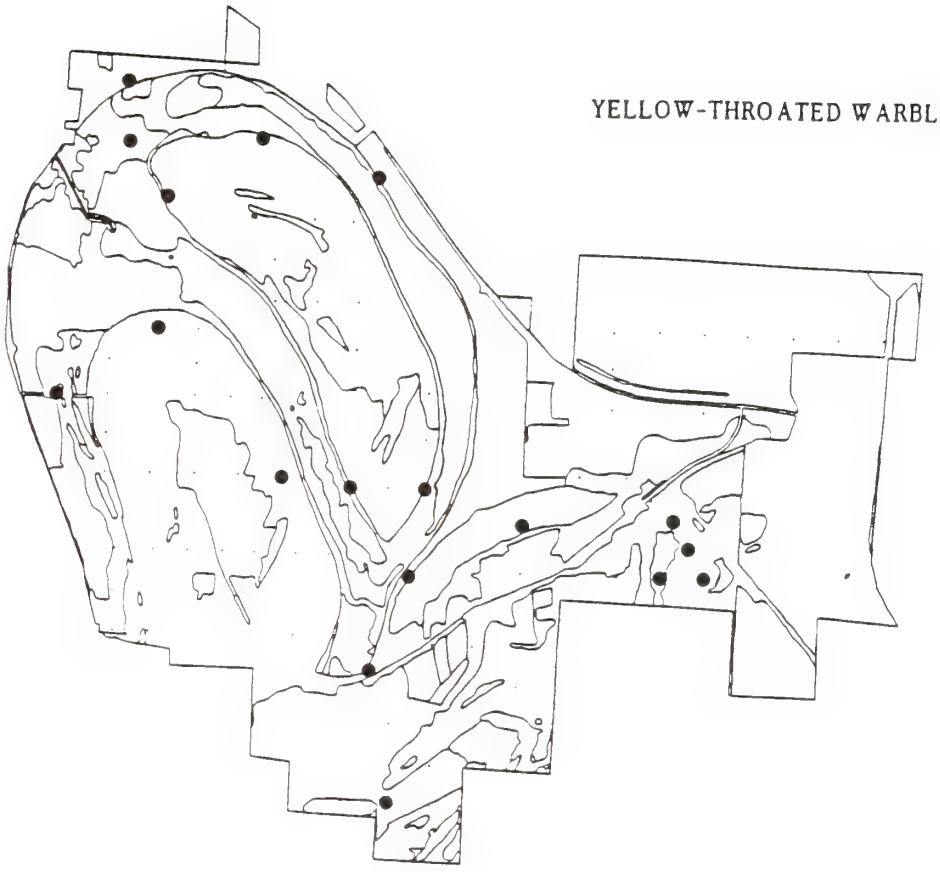
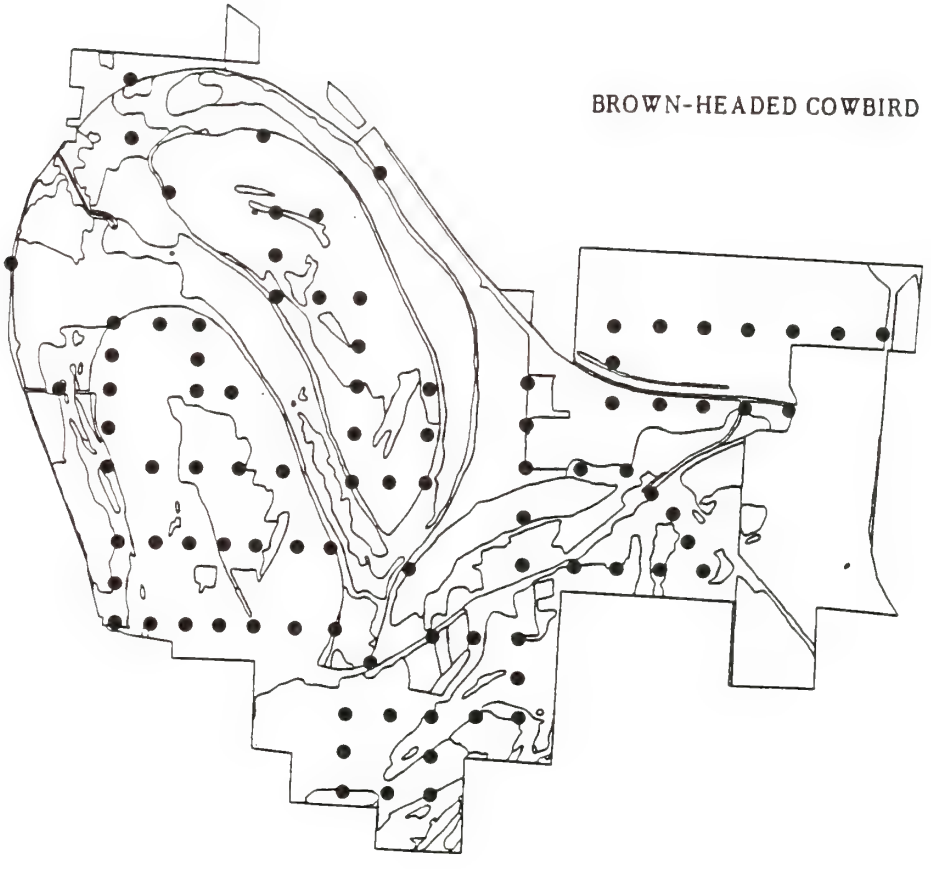


Figure 6-10. Census stops where yellow-throated warblers and brown-headed cowbirds were detected during avian community surveys conducted at Horseshoe Lake CA during May - June, 1993.

YELLOW-THROATED WARBLER



BROWN-HEADED COWBIRD



Appendix 6-A. Tabulation in avian ecological investigation format of species recorded during avian community surveys conducted at Horseshoe Lake Conservation Area during May - June, 1993.

Observers: Jay Rubinoff
Cody Smout

AVIAN ECOLOGICAL INVESTIGATIONS TABULATION SHEET

SITE: Horseshoe Lake Conservation Area

Address: (JR) RR3, Box 511
Murphysboro, IL 62966

Year: 1993

Species (A.O.U. order[1])	Total Number[2] of Different TRANSECT LEGS Species	CENSUS STOPS Recorded	Species Present in Additional Habitats[3]	Estimated[4] Population	Habitat[5] Preferences
BCNH	0	1	0	1-5	FC
GRHE	5	10	4	6-15	FC,SW,FF
LBHE	6	6	1	6-15	CR,SW
CAEG	7	4	1	6-15	CR,SF,FC
SNEG	1	1	0	1-5	CR,FC,SW
GREG	1	5	1	1-5	FC,FC,OW
GBLH	20	17	5	16-50	FC,
CAGO	2	0	1	16-50	OW,DL
MALL	1	4	0	1-5	FC,FF,SW,OW
BWTE	0	2	0	1-5	FF,SW
WODU	23	24	8	> 50	FC,FF,SW
HOME	0	1	0	1-5	FF,SW
KILL	5	7	4	6-15	CR,DL,SF
TUVU	1	0	0	1-5	DL,CR,SF
BAEG	0	1	2	1-5	OW,SW
MIKI	3	4	0	1-5	CR,F,SW,
RSHA	5	5	2	1-5	F,FF,SW,SF
BWHA	1	0	0	1-5	F
RTHA	5	9	3	1-5	F,SF
AMKE	1	0	0	1-5	SF,DL
NOBO	10	8	2	6-15	CR,F,SF,DL
WITU	0	1	0	1-5	F
RODO	1	1	0	1-5	DL,CR
MODO	30	26	8	> 50	CR,DL,F
YBCU	44	34	9	> 50	F,FF
GHOW	1	2	0	1-5	F,FF,SW
BAOW	5	6	0	1-5	F,FF,SW
SCOW	1	0	0	1-5	F

[1] A.O.U. = American Ornithologists' Union.
[2] Number of different Transect Legs and Census Stops where species was recorded.
[3] Number of different qualitative census stops where species was recorded.
[4] Estimated number of breeding pairs.
[5] CR = cropland, FC = flooded crop, F = forest, FF = flooded forest, SW = swamp, SF = successional field, DL = developed land, OW = open water.

Observers: Jay Rubinoff
Cody Smout

AVIAN ECOLOGICAL INVESTIGATIONS TABULATION SHEET

SITE: Horseshoe Lake Conservation Area

Address: (JR) RR3, Box 511
Murphysboro, IL 62966

Year: 1993

Species (A.O.U. order[1])	Total Number[2] of Different TRANSECT LEGS Species	CENSUS STOPS Recorded	Species Present in Additional Habitats[3]	Estimated[4] Population	Habitat[5] Preferences
CHSW	28	16	7	16-50	CR,DL,SW
RTHU	27	17	6	16-50	F,SF
BEKI	3	7	1	1-5	FC,SW
NOFL	18	25	6	16-50	F,FF
RBWO	36	28	9	> 50	F,FF,SW
RHWO	35	30	8	> 50	F,FF,SW
DOWO	28	28	8	16-50	F,FF,SW
HAWO	17	20	4	16-50	F,FF
PIWO	22	18	2	16-50	F,FF,SW
EAKI	10	13	5	6-15	SF,CR,SW
GCFL	31	32	8	> 50	F,FF
OSFL	0	1	0	M	M
EWPE	42	33	9	> 50	F,FF
EAPH	2	0	1	1-5	F,FC,SF
LEFL	1	0	0	M	M
ACFL	39	36	8	> 50	F,FF,SW
WIFL	0	1	0	M	M
YBFL	6	6	0	M	M
HOLA	6	11	3	16-50	CR
TRSW	1	1	1	1-5	CR,OW
PUMA	7	5	7	6-15	CR,SF,DL
RWSW	3	1	4	6-15	CR,OW
BASW	9	6	2	6-15	CR,DL,FC,OW
BLJA	18	18	3	16-50	F,DL
AMCR	41	32	8	> 50	F,SF,DL
FICR	8	9	1	6-15	FF,SW
TUTI	40	40	9	> 50	DL,F
CACH	34	31	7	> 50	F,FF,DL

[1] A.O.U. = American Ornithologists' Union.
[2] Number of different Transect Legs and Census Stops where species was recorded.
[3] Number of different qualitative census stops where species was recorded.
[4] Estimated number of breeding pairs.
[5] CR = cropland, FC = flooded crop, F = forest, FF = flooded forest, SW = swamp, SF = successional field, DL = developed land, OW = open water.

Observers: Jay Rubinoff
Cody Smout

AVIAN ECOLOGICAL INVESTIGATIONS TABULATION SHEET

SITE: Horseshoe Lake Conservation Area

Address: (JR) RR3, Box 511
Murphysboro, IL 62966

Year: 1993

Species (A.O.U. order[1])	Total Number[2] of Different TRANSECT LEGS Species	Total Number[2] of Different CENSUS STOPS Recorded	Species Present in Additional Habitats[3]	Estimated[4] Population	Habitat[5] Preferences
WBNU	20	23	4	16-50	F,FF,SW
CAWR	41	39	9	> 50	F,FF
BGGN	35	34	8	> 50	F,FF
EABL	8	8	4	6-15	SF,CR
WOTH	24	22	7	16-50	F,FF,SW
SWTH	1	0	1	M	M
AMRO	20	15	8	16-50	DL
GRCA	2	1	0	1-5	F,FF
NOMO	5	5	1	1-5	SF,DL
BRTH	6	7	2	6-15	F,SF
CEWA	3	5	0	M	M
EUST	7	3	1	6-15	CR,DL
WEVI	11	13	4	16-50	F,FF
YTVI	18	21	2	16-50	F,FF
BEVI	0	1	0	M	M
REVI	12	19	1	6-15	F
WAVI	16	11	6	16-50	F,DL
PHVI	0	1	0	M	M
PRWA	24	28	8	> 50	FF,SW
BWWA	0	2	0	M	M
NAWA	0	1	0	M	M
NPWA	26	24	4	16-50	F,FF,SW
CERW	2	2	1	1-5	F
CSWA	0	1	0	M	M
BLWA	0	1	0	M	M
MAWA	0	1	0	M	M
YRWA	0	2	0	M	M
BTGW	0	2	0	M	M

[1] A.O.U. = American Ornithologists' Union.
[2] Number of different Transect Legs and Census Stops where species was recorded.
[3] Number of different qualitative census stops where species was recorded.
[4] Estimated number of breeding pairs.
[5] CR = cropland, FC = flooded crop, F = forest, FF = flooded forest, SW = swamp, SF = successional field, DL = developed land, OW = open water.

Observers: Jay Rubinoff
Cody Smout

AVIAN ECOLOGICAL INVESTIGATIONS TABULATION SHEET

SITE: Horseshoe Lake Conservation Area

Address: (JR) RR3, Box 511
Murphysboro, IL 62966

Year: 1993

Species (A.O.U. order[1])	Total Number[2] of Different TRANSECT LEGS Species	CENSUS STOPS Recorded	Species Present in Additional Habitats[3]	Estimated[4] Population	Habitat[5] Preferences
YTWA	5	5	8	6-15	FF,SW
YEWA	0	0	1	1-5	SW
MOWA	1	0	0	M	M
KEWA	8	8	0	6-15	F
HOWA	0	2	0	M	M
COYE	29	34	9	> 50	DL,SW
YBCH	8	5	2	6-15	SF
AMRE	0	2	0	1-5	F,SW
NOCA	41	38	9	> 50	F,FF,DL
INBU	38	37	9	> 50	F/CR,DL
RSTO	4	12	1	6-15	SF,F/CR
GRSP	2	2	1	1-5	CR,SF
SOSP	18	7	3	16-50	CR/F,DL
FISP	18	20	2	16-50	CR,SF
CHSP	3	2	0	1-5	DL
DICK	21	22	3	> 50	CR,SF
BOBO	0	1	0	M	M
EAME	22	23	3	16-50	CR,SF
RWBL	36	33	9	> 50	CR,SW,DL,SF
BHCO	43	41	9	> 50	CR,F,FF
COGR	39	40	9	> 50	CR,F
ORCR	10	6	4	6-15	DL,SF
NOOR	11	15	0	6-15	DL,SF
SCTA	0	1	0	M	M
SUTA	6	16	3	6-15	F
HOSP	5	5	2	6-15	DL
AMGO	34	28	9	> 50	F/CR
HOFI	3	0	2	1-5	DL

[1] A.O.U. = American Ornithologists' Union.
[2] Number of different Transect Legs and Census Stops where species was recorded.
[3] Number of different qualitative census stops where species was recorded.
[4] Estimated number of breeding pairs.
[5] CR = cropland, FC = flooded crop, F = forest, FF = flooded forest, SW = swamp, SF = successional field, DL = developed land, OW = open water.

Appendix 6-B. Completed vegetation stratum ranking data forms for transects 1, 2, and 5 at Horseshoe Lake Conservation Area. Vegetation data were not recorded on the remaining 3 transects or qualitative census stops due to flooding before vegetation surveys were completed.

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 1 Page 1 of 1

Observer MARK BASINGER Community Type of Census Stop Developed Land - Primitive Camping Area Date 19 June 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Taxodium distichum	4
Liquidambar styraciflua	3
Platanus occidentalis	4

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR
Campsis radicans	1
Eleocharis obtusa	2
Trifolium repens	3
Rorippa sylvestris	3
Graticola neglecta	2
Taraxacum officinale	2
Krigia caespitosa	2
Polygonum cespitosum v. longisetum	1
Oxalis stricta	1
Plantago rugelii	1
Lepidium virginicum	1
Diodia virginiana	1

STRATUM Ground Layer Species	SR
Carex annectens	1
Medicago lupulina	2
Festuca pratensis	3
Juncus tenuis	2
Phyla lanceolata	1
Kummerowia striata	2

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 2 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Cropland - Corn / Soybean Field Date 19 June 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR	STRATUM Saplings Species	SR	STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR	STRATUM Species	SR	STRATUM Species	SR
Glycine max	7				
Zea mays	7				
Chamaesyce maculata	2				
Chamaesyce supina	2				
Xanthium strumarium	1				
Cynanchum laeve	2				
Sicyos halepense	3				

COMMUNITY TYPES

Forests: Upland Forest; Sand Forest; Floodplain Forest; Flatwoods

Prairies: Prairie; Sand Prairie; Gravel Prairie; Hill Prairie; Shrub Prairie

Savanna: Savanna; Sand Savanna; Barren

Wetland: Marsh; Swamp; Bog; Fen; Sedge Meadow

Surface Water: Lake Michigan; Reservoir; Impoundment; Stream; Natural Lake

Cropland

Forageland

Succesional Field

Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 3 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Developed Land - Campground with Facilities Date 19 June 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees — Species	SR
Taxodium distichum	5
Liquidambar styraciflua	4
Platanus occidentalis	4

STRATUM Saplings — Species	SR

STRATUM Shrubs — Species	SR

STRATUM Ground layer — Species	SR
Trifolium repens	3
Plantago rugelii	1
Krigia caespitosa	1
Kummerowia striata	2
Taraxacum officinale	2
Poa annua	1
Oxalis stricta	1
Diodia virginiana	1
Cynodon dactylon	2
Lolium perenne	1
Polygonum cespitosum v. longisetum	1
Stellaria media	1

STRATUM Ground Layer — Species	SR
Rumex crispus	1

STRATUM — Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 4 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Developed Land - Mowed Strip before Lake. Date 19 June 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees — Species	SR
Taxodium distichum	4
Platanus occidentalis	4
Liquidambar styraciflua	4

STRATUM Saplings — Species	SR

STRATUM Shrubs — Species	SR

STRATUM Ground layer — Species	SR
Allium vineale	1
Medicago lupulina	2
Trifolium repens	2
Carex blanda	2
Viola sororia	2
Kummerowia striata	2
Oxalis stricta	1
Muhlenbergia schreberi	3
Trifolium campestre	2
Hordeum pusillum	2
Arenaria serpyllifolia	1
Cerastium vulgatum	1

STRATUM Ground Layer — Species	SR
Bromus tectorum	2
Rumex acetosella	1
Plantago rugelii	2
Oxalis virginiana	1
Vitis vulpina	2
Conyza canadensis	1
Krigia caespitosa	1
Taraxacum officinale	2

STRATUM — Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 5 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Behind white house-Date 19 June 1993
cropland edge

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Acer saccharinum	5
Pyrus communis	3

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR
Trifolium repens	2
Kummerowia striata	2
Plantago rugelii	2
Krigia caespitosa	2
Toxicodendron radicans	2
Muhlenbergia schreberi	4
Arenaria serpyllifolia	1
Ampelopsis cordata	1
Oxalis stricta	1
Glycine max	5
Sorghum halepense	3
Matricaria matricarioides	2

STRATUM Ground Layer Species	SR
Hordeum pusillum	2
Polygonum arenastrum	2
Poa annua	2
Taraxacum officinale	2
Rumex crispus	1
Juncus tenuis	2
Bromus commutatus	1
Geranium carolinianum	1
Cynodon dactylon	2
Conyza canadensis	1
Oenothera laciniata	1
Polygonum persicaria	1

STRATUM Ground Layer Species	SR
Trifolium campestre	2
Lepidium virginicum	1
Plantago aristata	1
Xanthium strumarium	1
Trifolium pratense	2

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 6 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Waste Ground between Cropland and Floodplain Forest Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Populus deltoides	4
Celtis laevigata	4

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR
Prunus persica	4

STRATUM Ground layer Species	SR
Phytolacca americana	5
Sorghum halepense	5
Torilis japonica	4
Apocynum cannabinum	3
Parietaria pensylvanica	3
Boehmeria cylindrica	2
Rubus spp.	3
Cirsium discolor	2
Vitis cinerea	4
Impatiens capensis	4
Bromus commutatus	3
Ampelopsis cordata	4

STRATUM Ground layer Species	SR
Chenopodium album	2
Artemisia annua	2
Triticum repens	3
Erigeron strigosus	3
Erigeron annuus	3
Solidago canadensis	3
Triticum campestre	3
Festuca pratensis	4
Hibiscus lasiocarpus	2
Allium vineale	2
Plantago rugelii	2
Rumex crispus	2

STRATUM Ground layer Species	SR
Solanum carolinense	2
Kummerowia striata	3
Polygonum arenastrum	2

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie		Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 7 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Mesic Woods - Floodplain Forest Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees — Species	SR
Liquidambar styraciflva	4
Liriodendron tulipifera	4
Quercus pagoda	4
Quercus shumardii	4

STRATUM Saplings — Species	SR
Sassafras albidum	2
Asimina triloba	3
Morus rubra	1

STRATUM Shrubs — Species	SR
Asimina triloba	5
Sassafras albidum	3
Carya laciniosa	2

STRATUM Ground layer — Species	SR
Vitis cinerea	3
Parthenocissus quinquefolia	3
Galium triflorum	3
Impatiens capensis	3
Carex socialis	3
Carex typhina	3
Sanicula gregaria	2
Viola sororia	2
Vitis vulpina	2
Podophyllum peltatum	3
Galium obtusum	2
Arisaema dracontium	2

STRATUM Ground Layer — Species	SR
Smilax hispida	2
Carex jamesii	2
Crytotaenia canadensis	2
Toxicodendron radicans	3
Menispermum canadense	2

STRATUM — Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 1 Census Stop # 8 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Cropland - Soybean Field Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR	STRATUM Saplings Species	SR	STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR	STRATUM Species	SR	STRATUM Species	SR
Glycine max	8				
Cynanchum laeve	3				
Chamaesyce maculata	2				
Chamaesyce supina	2				
Xanthium strumarium	2				
Ipomoea purpurea	2				
Ipomoea hederacea	1				
Sorghum halepense	3				

COMMUNITY TYPES

Forests
- Upland Forest
- Sand Forest
- Floodplain Forest
- Flatwoods

Prairies
- Prairie
- Sand Prairie
- Gravel Prairie
- Hill Prairie
- Shrub Prairie

Savanna
- Savanna
- Sand Savanna
- Barren

Wetland
- Marsh
- Swamp
- Bog
- Fen
- Sedge Meadow

Surface Water
- Lake Michigan
- Reservoir
- Impoundment
- Stream
- Natural Lake

Cropland

Forageland

Succesional Field

Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 1 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Developed Land - Picnic Area Date 19 June 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Taxodium distichum	5
Liquidambar styraciflua	4
Platanus occidentalis	4

STRATUM Saplings Species	SR
Morus alba	1

STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR
Allium vineale	1
Toxicodendron radicans	1
Oxalis stricta	2
Cerastium vulgatum	2
Trifolium repens	2
Polygonum cespitosum v. longisetum	2
Conyza canadensis	2
Hordeum pusillum	2
Muhlenbergia schreberi	3
Taraxacum officinale	2
Plantago rugelii	1
Juncus tenuis	2

STRATUM Ground Layer Species	SR
Kummerowia striata	2
Festuca pratensis	3
Triodanis perfoliata	2
Geranium carolinianum	1
Parthenocissus quinquefolia	1
Carex blanda	2
Arenaria serpyllifolia	1

STRATUM Species	SR

COMMUNITY TYPES

Forests: Upland Forest; Sand Forest; Floodplain Forest; Flatwoods

Prairies: Prairie; Sand Prairie; Gravel Prairie; Hill Prairie; Shrub Prairie

Savanna: Savanna; Sand Savanna; Barren

Wetland: Marsh; Swamp; Bog; Fen; Sedge Meadow

Surface Water: Lake Michigan; Reservoir; Impoundment; Stream; Natural Lake

Cropland

Forageland

Succesional Field

Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 2 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Mesic - Floodplain Forest Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Carpinus caroliniana	4
Liquidambar styraciflua	4
Quercus michauxii	4
Celtis laevigata	3
Quercus pagoda	4
Carya laciniosa	3
Carya aquatica	3
Sassafras albidum	3

STRATUM Saplings Species	SR
Lindera benzoin	2
Liriodendron tulipifera	1
Morus rubra	1
Cercis canadensis	1
Sassafras albidum	1

STRATUM Shrubs Species	SR
Asimina triloba	5
Aesculus pavia	3

STRATUM Ground layer Species	SR
Toxicodendron radicans	3
Parthenocissus quinquefolia	3
Menispermum canadense	2
Sanicula gregaria	2
Viola sororia	2
Smilax hispida	2
Impatiens capensis	2
Boehmeria cylindrica	2
Carex sp.	2
Bidens frondosa	2
Pilea pumila	2
Geum canadense	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 3 Page 1 of 1

Observer _____ Community Type of Census Stop Cropland - plowed field not yet planted Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
€	

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR
Campsis radicans	4
Digitaria sanguinalis	4
Ambrosia artemisiifolia	2
Solanum carolinense	2
Ipomoea purpurea	2
Cynanchum laeve	2
Eclipta prostrata	1
Allium vineale	2
Ipomoea lacunosa	2
Ipomoea hederacea	2
Zea mays	4
Conzya canadensis	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 4 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Bottomland - Floodplain Forest Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Acer saccharinum	5
Nyssa aquatica	3
Taxodium distichum	4
Salix nigra	3
Diospyros virginiana	3
Fraxinus pennsylvanica	3

STRATUM Saplings Species	SR
Taxodium distichum	2
Acer saccharinum	2
Celtis laevigata	2
Fraxinus pennsylvanica	2

STRATUM Shrubs Species	SR
Cephalanthus occidentalis	3

STRATUM Ground layer Species	SR
Bidens discoidea	4
Lycopus rubellus	3
Boehmeria cylindrica	3
Ampelopsis cordata	3
Toxicodendron radicans	2
Asclepias perennis	2
Campsis radicans	2
Triadenum walteri	2
Saururus cernuus	2
Ludwigia polycarpa ssp. glabrescens	2
Echinodorus cordifolius	2

STRATUM Ground Layer Species	SR
Leersia oryzoides	2

STRATUM Species	SR

COMMUNITY TYPES

Forests: Upland Forest; Sand Forest; Floodplain Forest; Flatwoods

Prairies: Prairie; Sand Prairie; Gravel Prairie; Hill Prairie; Shrub Prairie

Savanna: Savanna; Sand Savanna; Barren

Wetland: Marsh; Swamp; Bog; Fen; Sedge Meadow

Surface Water: Lake Michigan; Reservoir; Impoundment; Stream; Natural Lake

Cropland

Forageland

Succesional Field

Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 5 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest with adjacent old RR track & ballast. Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Ulmus rubra	4
Celtis laevigata	4
Acer rubrum v. drummondii	4
Fraxinus pennsylvanica	4
Acer saccharinum	3
Morus rubra	3

STRATUM Saplings Species	SR
Fraxinus pennsylvanica	1

STRATUM Shrubs Species	SR
Ilex decidua	3
Sambucus canadensis	3
Liquidambar styraciflua	2

STRATUM Ground layer Species	SR
Geum canadense	3
Carex sp.	2
Toxicodendron radicans	4
Rubus sp.	3
Parthenocissus quinquefolia	2
Phytolacca americana	2
Arisaema dracontium	2
Vitis vulpina	1
Smilax hispida	2
Sanicula gregaria	2
Campsis radicans	2
Eupatorium rugosum	3

STRATUM Ground Layer Species	SR
Parietaria pensylvanica	2
Perilla frutescens	3
Ambrosia artemisiifolia	2
Sicyos angulatus	2
Pilea pumila	2
Elymus virginicus	2
Torilis japonica	2
Sorghum halepense	3
Erigeron annuus	2

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 6 Page 1 of 2

Observer Mark Basinger Community Type of Census Stop Cropland, though not farmed for several years. Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees	SR
Species	

STRATUM Saplings	SR
Species	
Liquidambar styraciflua	3
Ulmus rubra	2
Acer rubrum	2
Acer negundo	2
Cephalanthus occidentalis	3

STRATUM Shrubs	SR
Species	

STRATUM Ground layer	SR
Species	
Toxicodendron radicans	2
Cyperus strigosus	4
Allium vineale	2
Pyrrhopappus carolinianus	3
Bromus commutatus	3
Rumex acetosella	3
Rumex crispus	2
Triticum aestivum (old culms)	5
Oenothera laciniata	2
Conyza canadensis	2
Polygonum persicaria	3
Xanthium strumarium	2

STRATUM Ground Layer	SR
Species	
Hypericum mutilum	2
Cynanchum laeve	2
Lepidium virginicum	2
Vicia villosa	2
Solanum carolinense	2
Kummerowia striata	3
Cyperus ovularis	2
Vulpia myuros	3
Plantago virginica	2
Plantago aristata	2
Cyperus esculentus	2
Eleocharis obtusa	4

STRATUM Ground Layer	SR
Species	
Juncus marginatus	2
Echinochloa crus-galli & E. muricata	3
Alisma plantago-aquatica v. parviflorum	3
Heteranthera limosa	2
Bidens spp.	4
Ammannia coccinea	2
Scirpus americanus	2
Cyperus iria	2
Verbena urticifolia	2
Barbarea vulgaris v. arcuata	3

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie		Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 6 Page 2 of 2

Observer Mark Basinger Community Type of Census Stop Cropland, though not farmed for several years. Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR	STRATUM Saplings Species	SR	STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR	STRATUM Species	SR	STRATUM Species	SR
Erigeron strigosus	3				
Erigeron annuus	3				

Forests
- Upland Forest
- Sand Forest
- Floodplain Forest
- Flatwoods

Prairies
- Prairie
- Sand Prairie
- Gravel Prairie
- Hill Prairie
- Shrub Prairie

COMMUNITY TYPES

Savanna
- Savanna
- Sand Savanna
- Barren

Wetland
- Marsh
- Swamp
- Bog
- Fen
- Sedge Meadow

Surface Water
- Lake Michigan
- Reservoir
- Impoundment
- Stream
- Natural Lake

Cropland

Forageland

Succesional Field

Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 7 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Cropland, corn field. Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR

STRATUM Ground layer Species	SR
Zea mays	8
Cynanchum laeve	3
Solanum carolinense	2
Campsis radicans	2
Xanthium strumarium	2
Chamaesyce maculata	2
Chamaesyce supina	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 2 Census Stop # 8 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Mesic-floodplain Date 5 July 1993

Forest Strip at Lake edge.

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Fraxinus pennsylvanica	4
Gymnocladus dioicus	4
Quercus shumardii	4
Celtis laevigata	4
Diospyros virginiana	3

STRATUM Saplings Species	SR
Asimina triloba	2
Carya glabra	1
Quercus sp.	2
celtis laevigata	2
Quercus macrocarpa	1
Gymnocladus dioicus	1

STRATUM Shrubs Species	SR
Cornus drummondi	3
Asimina triloba	4
Fraxinus pennsylanica	2
Celtis laevigata	2
Ilex decidua	2

STRATUM Ground layer Species	SR
Saururus cernuus	3
Menispermum canadense	2
Smilax hispida	2
Smilax bona-nox	3
Parthenocissus quinquefolia	3
Arisaema dracontium	2
Boehmeria cylindrica	3
Sanicula gregaria	2
Geum canadense	2
Carex jamesii	2
Toxicodendron radicans	4

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 1 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Carya laciniosa	4
Quercus michauxii	5
Ulmus rubra	3
Quercus palustris	5

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR
Crataegus viridis	3
Celtis laevigata	2
Asimina triloba	3

STRATUM Ground layer Species	SR
Toxicodendron radicans	8
Campsis radicans	3
Arisaema dracontium	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 2 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 5 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees — Species	SR
Ulmus rubra	3
Fraxinus profunda	3
Quercus pagoda	4
Acer rubrum v. drummondii	4
Carya laciniosa	4

STRATUM Saplings — Species	SR
Acer rubrum v. drummondii	3
Quercus spp.	3
Ulmus rubra	2

STRATUM Shrubs — Species	SR
Fraxinus pennsylvanica	2
Liquidambar styraciflua	3
Ulmus rubra	3
Diospyros virginiana	1
Nyssa sylvatica	1
Crataegus viridis	2

STRATUM Ground layer — Species	SR
Toxicodendron radicans	8
Carex sp.	3
Arisaema dracontium	2
Leersia lenticularis	3
Galium obtusum	2
Campsis radicans	2
Vitis cinerea	1

STRATUM — Species	SR

STRATUM — Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 3 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Carya laciniosa	4
Quercus lyrata	4
Quercus palustris	4
Acer rubrum V. drummondii	4

STRATUM Saplings Species	SR

STRATUM Shrubs Species	SR
Liquidambar styraciflua	2
Acer rubrum V. drummondi.	3
Celtis laevigata	1
Fraxinus pennsylvanica	1

STRATUM Ground layer Species	SR
Saururus cernuus	3
Carex louisianica	3
Smilax hispida	3
Leersia lenticularis	2
Impatiens capensis	3
Carex sp.	2
Toxicodendron radicans	5
Scutellaria lateriflora	2
Campsis radicans	2
Glyceria striata	2
Boehmeria cylindrica	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 4 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Quercus pagoda	4
Quercus macrocarpa	4
Acer rubrum v. drummondii	4
Quercus palustris	4
Carya laciniosa	4

STRATUM Saplings Species	SR
Quercus spp.	2

STRATUM Shrubs Species	SR
Styrax americana	3
Fraxinus pennsylvanica	1
Ulmus rubra	2

STRATUM Ground layer Species	SR
Saururus cernuus	3
Impatiens capensis	2
Boehmeria cylindrica	3
Asclepias perennis	2
Toxicodendron radicans	3
Glyceria striata	2
Scutellaria lateriflora	2
Pilea pumila	2
Carex sp.	3

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 5 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Quercus palustris	6
Acer rubrum v. drummondii	3
Ulmus rubra	2

STRATUM Saplings Species	SR
Quercus spp.	3

STRATUM Shrubs Species	SR
Ulmus rubra	2
Acer rubrum v. drummondii	3

STRATUM Ground layer Species	SR
Saururus cernuus	3
Leersia lenticularis	2
Bidens discoidea	2
Scutellaria lateriflora	2
Boehmeria cylindrica	2
Asclepias perennis	3

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Sand Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Barren	Fen	Stream
	Shrub Prairie		Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 6 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees Species	SR
Ulmus rubra	3
Acer rubrum v. drummondii	5
Quercus palustris	4
Liquidambar styraciflua	4
Quercus michauxii	4
Quercus macrocarpa	4

STRATUM Saplings Species	SR
Quercus spp.	2
Acer rubrum v. drummondii	4
Fraxinus pennsylvanica	2

STRATUM Shrubs Species	SR
Cephalanthus occidentalis	2
Acer rubrum v. drummondii	3

STRATUM Ground layer Species	SR
Campsis radicans	3
Asclepias perennis	2
Bidens discoidea	2
Boehmeria cylindrica	2
Scutellaria lateriflora	2
Saururus cernuus	2

STRATUM Species	SR

STRATUM Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie		Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

STRATUM RANKING FORM

Site Horseshoe Lake Conservation Area Transect Set 5 Census Stop # 7 Page 1 of 1

Observer Mark Basinger Community Type of Census Stop Floodplain Forest Date 3 July 1993

Stratum Ranking

9 Dominant in essentially pure stand, no other species exceed SR2

8 Dominant, next lower species cannot exceed SR6

7 Codominants, two or possibly three species sharing dominance

6 Codominants, several species sharing dominance

5 Intermediate, common species with moderate cover

4 Intermediate, common species with low to moderate cover

3 Intermediate, several plants with minimal cover

2 Subordinate, two to several plants of inconsequential cover

1 Subordinate, only one individual noted

STRATUM Trees — Species	SR
Ulmus rubra	4
Liquidambar styraciflua	4
Acer saccharinum	4
Quercus palustris	3

STRATUM Saplings — Species	SR
Acer negundo	1
Gleditsia sp.	2
Nyssa sylvatica	1

STRATUM Shrubs — Species	SR
Crataegus viridis	3

STRATUM Ground layer — Species	SR
Aster onturionis	3
Impatiens capensis	2
Toxicodendron radicans	4
Parthenocissus quinquefolia	2
Stachys tenuifolia	2
Ranunculus septentrionalis	3
Oxalis stricta	2
Carex grayi	2
Carex grisea	2
Leersia virginica	3
Smilax hispida	2
Sanicula gregaria	2

STRATUM Ground Layer — Species	SR
Geum canadense	2
Elymus virginicus	2
Scutellaria nervosa	2
Galium obtusum	2
Carex sp.	2
Carex squarrosa	2

STRATUM — Species	SR

COMMUNITY TYPES

Forests	Prairies	Savanna	Wetland	Surface Water
Upland Forest	Prairie		Marsh	Lake Michigan
Sand Forest	Sand Prairie	Savanna	Swamp	Reservoir
Floodplain Forest	Gravel Prairie	Savanna	Bog	Impoundment
Flatwoods	Hill Prairie	Sand Savanna	Fen	Stream
	Shrub Prairie	Barren	Sedge Meadow	Natural Lake

Cropland Forageland Succesional Field Developed Land

JOB 7: FISH, UNIONID MUSSEL, CRAYFISH, AND SHRIMP SPECIES OF HORSESHOE LAKE AND LAKE CREEK

Brooks M. Burr and Roy C. Heidinger

PART ONE

SURVEY

Introduction

Historical Perspective

Illinois has a rich history of ichthyological investigations including the most complete and oldest historical data base for any state or province in all of North America (Burr 1991). Despite the monumental efforts involved in the production of the classic work on Illinois fishes by Forbes and Richardson (1908), no recorded information from that original survey is available for the fish fauna of Horseshoe Lake and immediately surrounding water bodies. The first published account of Horseshoe Lake fishes is that of Thompson and Bennett (1938). They recorded 26 species from the lake, relying on hoop nets as their primary method of sampling. They reported two species ("redhorse" [probably = golden redhorse, Moxostoma erythrurum] and "chub sucker" [probably = lake chubsucker, Erimyzon sucetta]), one of which (viz., golden redhorse) has not been recorded subsequently from the Horseshoe Lake area. During this same general period (1936), David H. Thompson of the Illinois Natural History Survey and Milton B. Trautman of the Ohio State University made three collections using seines from the the lake and spillway area and deposited their samples at the University of Michigan Museum of Zoology. Their samples (records examined by us) provided an additional 10 species not recorded by Thompson and Hunt (1938), including the first record of the cypress minnow, Hybognathus hayi, an Illinois endangered species, from the Horseshoe Lake spillway. Gerald E. Gunning (1954), under the tutelage of William M. Lewis at SIUC, produced a Master's Thesis on "The Fishes of Horseshoe Lake" and recorded a total of 28 species, including 10 additional kinds not reported by Thompson and Hunt (1938). Gunning used an electrofishing unit, nets, and traps to collect his samples. He reported three species, blue catfish (Ictalurus furcatus), flathead catfish (Pylodictis olivaris), and goldfish (Carassius auratus), that have rarely been reported from the area subsequently, although none would be unexpected after a flood event. The grand total of fish diversity recorded up through the mid-1950s was 44 species.

By the late 1950s, Roy Lockhart, a fishery biologist for the IDOC, had begun taking annual surveys of the Horseshoe

Lake fishery using an electrofishing unit. He added the longnose gar (Lepisosteus osseus) and the redear (Lepomis microlophus) to the growing list of fish diversity recorded from the lake. During the 1960s, Philip W. Smith and his colleagues from the Illinois Natural History Survey made 9 different collections in the area and recorded, in addition to other fishes, the first records of the brown bullhead (Ameiurus nebulosus), mud darter (Etheostoma asprigene), and central mudminnow (Umbra limi) from the lake as well as the first fish samples from the Lake Creek drainage. Smith's records were later reported on spot-distribution maps in the "Fishes of Illinois" (Smith 1979). During this same time period (1960s), Ora M. Price, fishery biologist for the IDOC, continued the annual sampling of the lake including detailed information on commercial fishing. In 1964 he reported additional records for the blue and flathead catfishes and the first record of the paddlefish (Polyodon spathula) from commercial trammel nets. Undoubtedly, his most valuable record was that of an alligator gar (Atractosteus spatula) measuring 67 inches (1.7 m), and captured in a trammel net in 1964. This species is now considered extirpated from Illinois, the last reports from state waters being from the 1960s. During the 1970s and 1980s annual electrofishing and seining samples were taken but no new fish species were added to the Horseshoe Lake fish fauna by IDOC fishery biologist Donald M. Garver and associates.

During the 1970s and 1980s IDOC introductions of threadfin shad (Dorosoma petenense) and channel catfish (Ictalurus punctatus) were made on several occasions. Beginning in 1979 and continuing to the present, B. M. Burr and students conducted a life history of the mud darter in Lake Creek (Cummings et al. 1984) including a list of fishes from the creek, reported the first records of the Illinois threatened bantam sunfish (Lepomis symmetricus) and banded pygmy sunfish (Elassoma zonatum) from the spillway (Burr et al. 1988), and reviewed the status of the Illinois endangered cypress minnow (Warren and Burr 1989), including records from the spillway. In 1992, R. C. Heidinger (SIUC) conducted a study for the IDOC on oxygen levels and the potential for fishkills due to oxygen depletion in Horseshoe Lake.

Objectives

The objectives of this portion of the Horseshoe Lake study were to: 1) review pertinent published literature, agency reports, and reports from private consultants on the fish biota of the Horseshoe Lake area; 2) complete field surveys and provide maps of locations of endangered and threatened species; 3) provide a list of fish species and the numbers taken at each site sampled; 4) review historical records of fishes from the Horseshoe Lake region; 5) provide records of crayfishes and unionid mussels taken during the

fish surveys; and 6) provide in the analysis of data and summary section an assessment and options on the effects of water level changes on fishes.

Methods

Our strategy was to sample the Horseshoe Lake region intensively in the spring, summer, and fall seasons of 1993 and the spring season of 1994. During each season we sampled the spillway, adjacent ditches, lower Lake Creek (2 sites) and Horseshoe Lake at a minimum of five [actually 17] stations (Figure 7-1) spread around the lake. Sampling gear for the spillway and lower Lake Creek included a 25 foot bag seine (3/16 inch mesh [5 mm]), and 10 foot [3.04 m] minnow seines (1/8 inch mesh [3 mm]). Sampling gear for Horseshoe Lake included seines used at a minimum of five pre-selected sites spaced around the perimeter of the lake, and a boat with an electrofishing unit for open-water sampling of large fishes. Boat electrofishing consisted of 60-minutes of effort each in three different regions (upper west arm, upper northeast arm, dam area) (Figure 7-1) of the lake for all three seasons in 1993 and spring of 1994. Because many fishes in lowland lakes and their tributaries are more active at night we sampled the spillway area and at least five sites on the lake at night during all three seasons. Boat electrofishing was also conducted at night during spring of 1993. Our use of the term "Horseshoe Lake region" or "Horseshoe Lake watershed" refers to the lake proper, Lake Creek from the Route 3 bridge and downstream, immediately adjacent ditches, and post-flood pools immediately adjacent to the lake.

At each site, all available macro- and microhabitats were sampled to assure that the maximum amount of fish diversity was encountered. The combination of seasonal as well as day/night sampling presumably yielded reasonably accurate information on taxonomic diversity, composition of lowland fish communities, and general abundance values.

The remarkable flooding event of 1993 altered sampling schedules and precluded adequate sampling of Lake Creek at the Route 3 bridge. This site was flooded continuously during the spring and summer, and only in late fall 1993 were we able to obtain a thorough sample of the fish fauna. It was again flooded during spring 1994. After the flood waters receded in late fall 1993 we sampled a number of post-flood pools as well as the lake and spillway in an effort to record fishes that had dispersed into the region during the flood. As expected a significant number of big-river fishes were present in the region and remained into the spring 1994.

Large fish that were readily identified in the field were returned unharmed to the waters from where they were taken. Small fishes known to be common in the region were

also returned unharmed. Rare or threatened/endangered species (e.g., cypress minnow) taken in samples were returned to their respective habitats. Voucher specimens of all species encountered are retained as a permanent record in the SIUC Ichthyological Collection.

During seining efforts we recorded the presence of the endangered oxbow crayfish, Orconectes lancifer, which in Illinois is known only from Horseshoe Lake (Page 1985). One of us (BMB) had collected the species in the lake over the past five years and can recognize the species on site. Individuals were identified and returned alive to the lake. In addition, unionid mussel shells (not live individuals) taken during routine sampling were returned to the laboratory for identification.

We canvassed museums with fish collections from southern Illinois in an effort to obtain all vouchered historical records of fishes from the Horseshoe Lake region. Records are available only from the University of Michigan Museum of Zoology (UMMZ), the Illinois Natural History Survey (INHS), and the SIUC Ichthyology Collection. Donald M. Garver, fishery biologist for the IDOC, was contacted to obtain copies of reports of annual fish samples conducted on Horseshoe Lake since the late 1950s. We reviewed the available published and unpublished records of fishes from the region and the various recent reports from the 1980s and early 1990s.

Results

General Faunal Composition

A total of 80 fish species, representing 19 families, has been recorded from the Horseshoe Lake region since 1938 (Tables 7-1 to 7-5). Of these, 74 species are considered native, and 6 occur in the region as a result of introductions of exotics, very recent dispersal, or from transplantations of species native to other parts of the continent. Approximately 40% of the total (187 species) native fish fauna known from Illinois (Burr 1991) occur in the Horsheshoe Lake region. The native fish fauna of the region constitutes about 20% of the 375 freshwater fishes found in the Mississippi River basin (Burr and Mayden 1992). The five dominant families in terms of diversity are Cyprinidae (18 native species), Centrarchidae (12 native species), Catostomidae (9 native species), Ictaluridae (7 native species), and Percidae (6 native species); in total they comprise 70% (52 species) of the native fauna. The families Polyodontidae, Amiidae, Hiodontidae, Esocidae, Umbridae, Aphredoderidae, Poeciliidae, Atherinidae, Elassomatidae, and Sciaenidae are each represented by one extant native species.

Clear Creek, the next major stream to the north of Horseshoe Lake, has at least 90 native species (Kenneth M. Cook, pers. comm.) and the nearby Cache River has at least 71 native species (Burr and Page 1986). Considering differences in overall drainage size(i.e., the Cache River drains a much larger area than Horseshoe Lake), the Horseshoe Lake region has a reasonably diverse fish fauna. Differences in catchment size, habitat diversity, and geological history are among the most important factors influencing species diversity in the upper Mississippi basin (Burr and Page 1986).

Unusual fishes known from the region, that are apparently year-round residents with limited ranges in Illinois (Smith 1979) include the spotted gar (Lepisosteus oculatus), cypress minnow (Hybognathus hayi), pugnose minnow (Opsopoeodus emiliae), brown bullhead (Ameiurus nebulosus), central mudminnow (Umbra limi), banded pygmy sunfish (Elassoma zonatum), flier (Centrarchus macropterus), bantam sunfish (Lepomis symmetricus), redspotted sunfish (Lepomis miniatus), and mud darter (Etheostoma asprigene). The spillway below Horseshoe Lake, the most species rich site in the region, often yields over 25 species, including all of the species listed above except the brown bullhead and redspotted sunfish.

Erroneous and Corrected Fish Records

As with any major watered area in North America, a few fish species have been reported from the Horseshoe Lake region that remain unsubstantiated by voucher specimens or are considered erroneous. If recognized, they would constitute an extension of the range of a species, an enigmatic zoogeographic occurrence, or an improbable occurrence in a given habitat, or they could represent any of several similar species. Erroneous records are those misidentified as confirmed by examination of extant voucher specimens. Species reported from Horseshoe Lake that remain unsubstantiated include "redhorse" (probably golden redhorse, Moxostoma erythrurum, no voucher) and "chub sucker" (probably lake chubsucker, Erimyzon sucetta, no voucher), both reported by Thompson and Bennett (1938); spottail shiner, Notropis hudsonius (probably blacktail shiner, Cyprinella venusta, no voucher) and slender madtom, Schilbeodes insignis (an earlier name for what we now call the tadpole madtom, Noturus gyrinus), both reported by Gunning (1954); and the freckled madtom, Noturus nocturnus (= Noturus gyrinus [INHS 5998]) reported by Smith (1979). We consider the golden redhorse, lake chubsucker, and blacktail shiner to be a part of the native Horseshoe Lake fauna, at least historically. The tadpole madtom is a year-round resident.

1993-1994 Fish Surveys

The combination of boat electrofishing and seining during 1993 and spring of 1994 yielded a total of 34 species from seining and 27 species from boat electrofishing from the lake proper. An additional 29 species were captured seining in the spillway, lower lake Creek, and adjacent ditches and post-flood pools, bringing the total diversity in the region during 1993-1994 to 64 species in 19 families from 21 seining sites and 3 electrofishing sites.

Electrofishing.--The fish community (Tables 7-1 and 7-2) in the lake proper is dominated in biomass by suckers (Catostomidae), exotic minnows (Cyprinidae), sunfishes (Centrarchidae), temperate basses (Moronidae), shads (Clupeidae), and silversides (Atherinidae). In terms of year-round numerical abundance, electrofishing revealed that (in decreasing order of abundance) gizzard shad, bluegill (Lepomis macrochirus), redear, bigmouth buffalo, and white crappie (Pomoxis annularis) were the most common species. The brook silverside (Labidesthes sicculus) dominated open water during the summer months. A few species, skipjack herring (Alosa chrysochloris), goldeye (Hiodon alosoides), grass carp (Ctenopharyngodon idella), smallmouth buffalo (Ictiobus bubalus), white bass (Morone chrysops), and freshwater drum (Aplodinotus grunniens), either first appeared in electrofishing samples only after the flood or were more common after the flood (Tables 7-1 and 7-2). In fact, the skipjack herring and goldeye have never before been reported from Horseshoe Lake. Most year-round species were generally distributed throughout the three lake areas electrofished.

Seining.--Seine samples revealed results similar to electrofishing. Gizzard shad and several sunfishes (e.g., bluegill, both crappies) dominated in biomass the lake proper. Because of the susceptibility of small fishes to capture by seining the shoreline areas of the lake were dominated in numerical abundance by golden shiners (Notemigonus crysoleucas), mosquitofish (Gambusia affinis), brook silversides, bluegill, and orangespotted sunfish (Lepomis humilis) (Tables 7-3 and 7-4).

Fifteen species, paddlefish (Polyodon spathula), skipjack herring, Mississippi silvery minnow (Hybognathus nuchalis), silver chub (Macrhybopsis storeriana), river shiner (Notropis blennius), ghost shiner (Notropis buchanani), silverband shiner (Notropis shumardi), mimic shiner (Notropis volucellus), bullhead minnow (Pimephales vigilax), river carpsucker (Carpiodes carpio), quillback (Carpiodes cyprinus), white perch (Morone americana), sauger (Stizostedion canadense), and walleye (Stizostedion vitreum),

appeared in samples only after the flood (Tables 7-3 and 7-4) and clearly demonstrate the dispersal of a big-river fauna into the region. In fact, the silver chub, ghost shiner, silverband shiner, mimic shiner, bullhead minnow, white perch, sauger, and walleye, had never before been reported from the Horseshoe Lake region.

The spillway immediately below Horseshoe Lake proper was the most productive area in the region when considering fish diversity, biomass, and numerical abundance. Some 39 species were captured in the spillway area including large numbers of gizzard shad, brook silverside, yellow bass (Morone mississippiensis), white bass, bluegill, both crappies, and freshwater drum. Ditches adjacent to the lake typically contained bowfin (Amia calva), gizzard shad, common carp (Cyprinus carpio), golden shiner, smallmouth buffalo, black bullhead, mosquitofish, banded pygmy sunfish, flier (Centrarchus macropterus), warmouth (Lepomis gulosus), bluegill, both crappies, mud darter, and slough darter (Etheostoma gracile). Throughout the course of this study the fish fauna of Lake Creek was the most difficult to adequately sample. Beginning in spring 1993 the stream was flooded continuously until late fall 1993. Sampling revealed a decidely lowland lake fish community dominated by common carp, gizzard shad, mosquitofish, white bass, green sunfish (Lepomis cyanellus), and bluegill. This was in sharp contrast to a more typical lowland stream fauna that was well documented in the early 1980s by Cummings et al. (1984).

Endangered, Threatened, Extirpated, and Rare Fishes

Over the past 60 years at least one species, the alligator gar, is indicated as having been extirpated from the Horseshoe Lake region, and others are rare, uncommon, or distributionally problematic in the region. Four species known from the region have received conservation status rankings from the state of Illinois (Illinois Endangered Species Protection Board 1994): cypress minnow (Figure 7-2), bigeye shiner (Notropis boops), bantam sunfish, and redspotted sunfish. One other species, the blacktail shiner, is on the Illinois watch list (Burr 1991).

The alligator gar, a large-river and lowland species, was reported from Horseshoe Lake in 1964 by Ora M. Price, an IDOC fishery biologist. The individual was caught in a trammel net by a commercial fisherman, and measured 67 inches (1.7 m). Only two gar species in North America are known to reach that size (Page and Burr 1991), the longnose gar and alligator gar. Neither species could be misidentified by a competent fishery biologist. Price was familiar with both species and we accept the record of an alligator gar from Horseshoe Lake as valid even though a voucher specimen is unavailable for verification. This species rarely has been

seen anywhere in Illinois since the 1960s (Smith 1979) and has declined precipitously throughout the upper Mississippi River basin (Burr and Page 1986). It was formerly listed as endangered by the state of Illinois, but was delisted recently because it is considered extirpated in Illinois.

The cypress minnow was first collected from the spillway region on 14 June 1936 (UMMZ 111602, 7 specimens), and not again until 12 July 1984 (INHS 67350, 1 specimen). We collected 10 specimens (SIUC 21694, 3 vouchered) on 29 June 1993 in the spillway just below the dam. Warren and Burr (1989) suggested that drainage of floodplain wetlands for agriculture was a prime factor in the disappearance of the cypress minnow from several historical locations in Illinois. Wetlands adjacent to stream channels apparently were used by the species as spawning and nursery areas. This species has never been taken in the lake proper but apparently persists in lower Lake Creek. The monthly dates of capture of this species are all close in time and in the latter two collections specimens are small. There is apparently a very brief time window in the life history (i.e., post- spawning) of this species when juveniles are susceptible to standard sampling techniques.

The bigeye shiner has been collected only once in the region, from Lake Creek in 1964 (INHS 5937, 1 specimen). This species was recently upgraded from state threatened to state endangered based on disappearance of stream populations in east-central Illinois. Extensive monthly collections in Lake Creek from 1979 to 1982 did not reveal a single bigeye shiner. At least five collections made in Lake Creek since 1982 have yielded many other species but no bigeye shiners. This species occurs in much greater abundance in clear, clean upland tributaries of the nearby Clear and Orchard Creek systems; Lake Creek is lowland in character, is frequently flooded, and lacks strong permanent flow. We presume the single individual captured in 1964 was a waif from a more stable source pool in a nearby drainage. We consider this species extirpated from the Horseshoe Lake region.

The diminutive bantam sunfish was known previously in Illinois only from the LaRue-Pine Hills swamp and Wolf Lake in Union County (Smith 1979). During April and May of 1982, 9 individuals collected on four different dates were captured from the Horseshoe Lake spillway (Burr et al. 1988). These records were surprising in light of the numerous collections made at the spillway for many years by several independent investigators. This fish has not been reported since 1982 in spite of our recent intensive efforts to substantiate an extant population. The bantam sunfish is a state threatened species with a tiny Illinois range limited to only a few localities in Union and Alexander counties. We consider this species rare in the region and recognize that suitable

habitat remains in the lake, around the spillway, and in adjacent ditches.

All but one (viz., the pumpkinseed, Lepomis gibbosus) species of Lepomis occur in the Horseshoe Lake region. The rarest of these is apparently the redspotted sunfish, Lepomis miniatus. It has been recorded only twice, once in 1981 (SIUC 2577, 1 juvenile) from Lake Creek and once in 1987 (SIUC 15527, 1 juvenile) from lower Pigeon Roost Creek (a northwest tributary of Horseshoe Lake). The Horseshoe Lake region offers suitable habitat for this species but recent evidence of spawning and recruitment is lacking. We presume that redpsotted sunfish are still present in the region but in locations or microhabitats we did not sample.

During the course of status surveys conducted in 1992 (Taylor et al. 1994), the blacktail shiner was not found in the Horseshoe Lake region but was collected in nearby Orchard Creek and the mainstem Cache River at the Route 3 bridge. Recently (April 1994), we collected a single blacktail shiner from the spillway along with additional cyprinids (i.e., mimic and silverband shiners) never before reported from the region. Gunning (1954) reported the spottail shiner, Notropis hudsonius, from Horseshoe Lake, a record we consider here to represent the blacktail shiner (Table 7-5). We presume the recent record is a post-flood arrival into the region and is not as yet representative of an extant population. Habitat quality is marginal as judged from the soft mud substrate and lack of obvious spawning sites (e.g., crevices under bark on logs, between large rocks, etc. [Heins 1990]). This species is on the Illinois watch list and was recently recommended for threatened status (Taylor et al. 1994).

Based on Table 7-5, several other species may be considered extirpated or so rare as to not be susceptible to standard sampling techniques; the latter present problematic distributions in the region. In the mid-1930s and again in the 1960s, the "chubsucker" was reported from Horseshoe Lake. We presume this to be a reference to the lake chubsucker, Erimyzon succeta (Table 7-5) which is commonly found in swamps, bayous, and wetlands. This species occurs in nearly identical habitat in bottomland lakes of extreme western Kentucky (Burr and Warren 1986). More intensive collecting in the shallows of the lake proper is needed to substantiate this species in the region. Blue catfish and flathead catfish have periodically been reported from the lake since 1954 and we assume that flooding events provide new stock of these species from nearby big rivers on an irregular basis. Both Thompson and Bennett (1938) and Gunning (1954) reported the spotted sucker from the region. It has not been reported since their early studies and may be extirpated, although suitable habitat is present in Lake Creek. The longnose gar

has been periodically recorded in the lake and in Lake Creek, although voucher specimens are unavailable. This species is more typical of lotic waters but could periodically invade the lake after flooding events. We doubt that spawning occurs in the region. Other species in Table 7-5 have been discussed previously or represent cyprinids (i.e., central stoneroller, redfin shiner, suckermouth minnow) indicative of stream environments; all have been found previously in Lake Creek and will probably repopulate the creek once flooding subsides for a lengthy period.

Introduced Fishes

As with most impounded waters in the Midwest, exotic or transplanted sportfishes and forage species have been introduced or have dispersed into the Horseshoe Lake watershed. The presence of nonnative species raises questions as to their source, their ecological role in the lake, and their importance to human welfare. The potential ecological effects of introduced and exotic fish on native aquatic communities include habitat alterations (e.g., removal of vegetation, degradation of water quality); introduction of parasites and diseases; trophic alterations (e.g., predation, competition for food); and hybridization, and spatial alterations (e.g., overcrowding; Taylor et al. 1984).

The history of introductions into Horseshoe Lake apparently began in 1931 when largemouth bass, both crappies, bluegill, channel catfish, bullheads, common carp, and buffalofishes were brought from the Illinos River at Havana and put into Horseshoe Lake (Thompson and Bennett 1938). All of these species were previously native to the region. Few records of subsequent stockings exist until the 1970s when threadfin shad and channel catfish were introduced periodically in large numbers. Interestingly, out of thousands of shad captured in the lake, we have collected only a single threadfin shad and then only after a major flooding event during spring 1994; we presume this large adult dispersed into the area from either the Mississippi River rather than being representative of the stocked population.

Of the six introductions of nonnative species into the lake region, only one (threadfin shad) has been intentional. Most alarming is the recent documented presence of two exotic fishes (grass carp, Ctenopharyngodon idella and bighead carp, Hypophthalmichthys nobilis) previously unrecorded from the region. Young grass carp were taken from the spillway in spring 1993 and subadults were found in the lake in spring 1994. The presence of young indicates probable reproduction in the area. A subadult bighead carp was taken only once at the spillway, but young-of-the-year from the lower Big Muddy

River (Burr and Warren 1993) suggest that the species is reproducing and recruiting in Illinois waters. The common carp (Cyprinus carpio) was the first and only exotic found in the lake since the 1930s, and it remains the most common exotic species. Goldfish have been reported only once in the lake (Gunning 1954), but numerous recent records in southern Illinois following the receding 1993 flood waters demonstrate that a number of source pools are now available in the area. The most surprising record of a nonnative species is that of the white perch (Morone americana) from a post-flood pool adjacent to the lake. This species, native to Atlantic Slope drainages, has become established in the Great Lakes, has dispersed down the Illinois River, was recently (1994) taken in the Mississippi River near Grand Tower, and has moved as far south as Horseshoe Lake. Specimens captured are subadults and probably represent individuals spawned in the inland waters of Illinois.

Obviously, some of these introduced species are localized, uncommon, or apparently ecologically unimportant. We do not have enough information to predict the long-term effect of these introductions, but note that the ratio of extant native to introduced fish has decreased in very recent years. Given the model of the common carp, finding evidence of potential reproduction of grass carp in the region is disturbing. We might speculate that the lake fauna may be given over to these exotics, as it is to some extent now by the common carp.

Sport, Commercial, and Forage Fishes

Commercial fishing occurred in Horseshoe Lake up until the 1960s. Common carp and buffalofishes accounted for the bulk of the fishery with many samples examined by IDOC biologists that contained fish in the 10-25 pound range. Even though commercial fishing is no longer allowed on the lake, anglers remove a number of large buffalofishes and common carp each year by snagging them in the lake and spillway. In the 1930s, Thompson and Bennett (1938) estimated that the lake contained about one-half million pounds of common carp and buffalofishes, or about 200 pounds per acre. Our sampling indicates that carps and buffalofishes are still abundant in the lake and account for much of the biomass in the lake.

The most popular sportfishes in the lake are the crappies, bluegill (Lepomis macrochirus), redear, channel catfish (Ictalurus punctatus), and largemouth bass (Micropterus salmoides). A recent (1991) creel survey noted that about 16,000 angler trips are made to the lake each year (Bayley 1992). When compared with a 1968 creel survey, it was discovered that 55% fewer trips are currently made to Horseshoe Lake (Bayley 1992). The existence of several other

lakes (e.g., Cedar, Kincaid, Devil's Kitchen, Little Grassy, Rend, Lake of Egypt) in southern Illinois, including some relatively new ones is probably partly responsible for the reduction in angler usage at Horseshoe Lake. Bayley (1992) suggested that the continued sediment-related degradation of the lake, the concomitant loss of fish habitat, and a reduction in the amount of fishable areas may also help account for decreased angler usage of the lake. Bayley (1992) found that 65% of recent angler trips to the lake were for crappie and 20% for "any fish species." Bluegill and largemouth bass accounted for nearly 15% of the remaining interest from anglers. Angling opportunities have decreased since a 1968 creel survey due to increased degradation of fish habitat and increased mortality from fishkills. As shoreline areas continue to silt in, valuable spawning sites for bluegill and redear are destroyed. With decreasing water depths from siltation, the potential for increases in winter and summer fishkills becomes even greater. According to Bayley (1992), anglers seeking bluegill and redear have moved to other water bodies where harvest quality is improved.

The most abundant forage fishes in Horseshoe Lake include gizzard shad, golden shiner, brook silverside, pugnose minnow, and young Lepomis spp. All were common in our samples and appear to be generally distributed throughout the lake. Our sampling and that conducted annually by the IDOC has never recovered threadfin shad from the lake. Threadfin shad are known to winterkill in southern Illinois impoundments (Heidinger 1983).

Changes in Fish Assemblages

Without any question, the most dramatic changes observed in fish assemblages in Horseshoe Lake and Lake Creek occurred after the 1993 flood (Tables 7-1 to 7-4). As noted above, some 15 species appeared in samples after the flood that are not known historically to have been a part of the "typical" Horseshoe Lake fish fauna. Some indigenous species appeared to be more abundant after the flood including smallmouth buffalo, freshwater drum, and white bass. Lake Creek, which under normal flow conditions contains a lowland stream fish fauna dominated by the red shiner, tadpole madtom, mosquitofish, mud darter, gizzard shad, bluntnose darter, longear sunfish, slough darter, bluegill, ribbon shiner, blackspotted topminnow, emerald shiner, and bluntnose minnow, was given over after the flood to bowfin, common carp, buffalofishes, gizzard shad, mosquitofish, brook silverside, white bass, and bluegill. All of the latter species are indicative of lentic waters and demonstrate the impact that prolonged flooding can have on an otherwise lowland stream fauna.

Thompson and Bennett (1938) concluded that the 1937 flood had little impact on the fish fauna of the lake proper. The only species having invaded the lake after the flood was the spotted gar, a fish that was at that time known only from the spillway. The 1937 flood occurred during January and February when fish are less active which probably accounts for the observed lack of change in fish assemblages. It is difficult to make comparisons of the present day fish fauna with that of decades ago because sampling techniques, sampling gear, and unit effort have varied greatly over that time span. In addition, there is little quantitative data on the entire fauna, rather it is restricted largely to a few selected sportfishes.

Unionid Mussels

We obtained only two specimens representing two species of unionid mussel from the Horseshoe Lake area (Table 7-6). A fresh dead shell of the flat floater (Anodonta suborbiculata) was found near the dam in the lake proper and the threeridge (Amblema plicata) was found in Lake Creek near the Rt. 3 bridge. The Anodonta is typically found in ponds, lakes and other lentic habitats and would be predicted to occur in the lake. The Amblema is common throughout Illinois in both streams and impoundments (Cummings and Mayer 1992). Neither species is of conservation status concern and both are apparently rare in the area. The flat floater was previously known from Horseshoe Lake, the threeridge represents a new record for Lake Creek.

Crayfishes and Shrimps

We obtained records of eight different species of crayfishes and one shrimp from the Horseshoe Lake area (Tables 7-7 and 7-8). The shrimp (Palaemonetes kadiakensis) was abundant in all habitats and is known to be common in swamps and lowland lakes of southern Illinois (Page 1985). The most common species taken in seines around the perimeter of the lake, and in the spillway and adjacent ditches, were dwarf crayfishes (Cambarellus shufeldtii) and the red crayfish (Procambarus clarkii). Both of these species are common residents of southern Illinois swamps (Page 1985). The state endangered oxbow crayfish (Orconectes lancifer) was taken on three different occasions from both the lake and the spillway (Figure 7-3). According to Page (1985) this species is known in Illinois only from Horseshoe Lake and a mid-1800s record from Cairo collected by Robert Kennicott. All specimens captured were adults; they were examined, identified, and returned to their respective habitats. The other crayfish species captured were previously known from southern Illinois, although not specifically from Horseshoe Lake.

Discussion

Horseshoe Lake is unique in Illinois. The state has no other large cypress-tupelo lake on the Coastal Plain of Illinois that contains such a wide variety of unusual plants and animals (in part, Evers and Page 1977; this report). The overwintering geese attract to this area numerous hunters and bird watchers who, it is estimated, spend over a million dollars annually in Cairo and vicinity (Evers and Page 1977). Angling continues to be popular with a variety of desirable sportfishes available in sufficient quantity to satisfy a significantly large user group. All of the recognized groups of plants and animals have numerous examples of endangered and threatened species that in many cases have stable reproducing populations in the Horseshoe Lake ecosystem. To those who appreciate such things, the lake is picturesque and has aesthetic qualities difficult to quantify. Unfortunately, the watershed suffers from excessively high sedimentation rates (Lee et al. 1986) and uses that appear to be in conflict.

The spillway and lower Lake Creek drainage contain the most diverse fish assemblage in the watershed. The effects of silt buildup below the spillway (related to the proposed discharge protocol to remove silt) is an area of focus that warrants further study, especially since endangered species are known to be present. If a water-level regime is initiated (e.g., a drawdown or water level increase), then the fish community should be monitored in such a way that our historical data can be used as a baseline.

Periodic flooding and drought of the Horseshoe Lake watershed are both historical and natural phenomena that have enhanced the biodiversity of the region. The flood pulse is an environmental stimulus for spawning in many species associated with big rivers and lowland lakes. While a number of fish species invaded Horseshoe Lake during the flood, it is unlikely that many will recruit. Higher water levels in the lake resulting from either man-controlled devices or natural flooding from the Mississippi River probably have few negative impacts on the majority of the fish fauna. Flooding conditions contribute to a concentration of common carp and buffalofishes above and below the spillway where a fairly active snag fishery has developed. The buildup in biomass of common carp and buffalofishes in the lake proper is probably detrimental to the sport fishery which is made up largely of centrarchids. In contrast, decreased water levels and increasing sedimentation rates in an already shallow lake could bring about localized or complete fishkills in the winter because of anoxic conditions (especially if the lake is iced over for three to four weeks) (Heidinger 1992). Several days and nights of hot, calm, cloudy weather with

night time temperatures remaining in the mid-80° ranges could lead to an oxygen depletion in the summer (Heidinger 1992).

The unique ecological and economic value of the Horseshoe Lake watershed cannot be overstated. If sedimentation rates continue unabated and nothing is done from a management perspective Illinois will lose a large element of aquatic biodiversity that has existed on the floodplain for at least six thousand years.

Summary

1. Historical records document that a typical lowland lake fish fauna consisting of gars, bowfins, clupeids, a few cyprinids, buffalofishes, catfishes, sunfishes, temperate basses, silversides, and a few percids, has existed in the Horseshoe Lake watershed since at least the 1930s.

2. The 1993-1994 surveys documented the presence of 64 fish species in 19 families from the Horseshoe Lake watershed. In addition 9 crayfish and shrimp species and 2 unionid mussel species are known to occur in the watershed.

3. Including historical records and those from the 1993-1994 study, a total of 80 fish species in 19 families has been recorded from the watershed since 1938. Of these, 74 species are considered native, and 6 occur in the region as a result of introductions of exotics, very recent dispersal, or from transplantations of species native to other parts of the continent.

4. Many fishes invaded the watershed during the 1993 flood that had never before been recorded from the lake proper, spillway, adjacent ditches, or Lake Creek. These included the skipjack herring, goldeye, silver chub, ghost shiner, silverband shiner, mimic shiner, bullhead minnow, white perch, sauger, and walleye.

5. The capture of white perch in the Horseshoe Lake watershed documents the most southerly occurrence in the Mississippi River basin for this recently-invading species.

6. Four fish species known historically from the region have received conservation status rankings from the state of Illinois: cypress minnow, bigeye shiner, bantam sunfish, and redspotted sunfish. One other species, the blacktail shiner, is on the Illinois watch list. We obtained records for the cypress minnow and blacktail shiner, but were unable to substantiate the presence of the bigeye shiner, bantam sunfish, and redspotted sunfish. An overlooked 1964 record for a 67-inch alligator gar is available from the lake proper. This species is almost surely extirpated from the watershed and probably from Illinois.

7. The 1993-1994 surveys revealed the presence of exotic or nonnative species that were not known previously to occur in the Horseshoe Lake watershed. For the first time, young grass carp were taken in the spillway and subadults were present in the lake after the 1993 flood. A subadult bighead carp was taken in the spillway, none are yet available from the lake. Juvenile white perch were found in a post-flood pool adjacent to the south end of the lake. Historical records exist for goldfish and the common carp is still the most common exotic species in the lake. Nonnative threadfin shad have been introduced as forage.

8. Angling remains popular and the lake and spillway continue to provide fishing for such desirable sportfishes as bluegill, redear, both crappies, largemouth bass, and channel catfish. Large numbers of common carp and buffalofishes are also caught each year. A recent (1991) creel survey noted that at least 16,000 angler trips are made to the lake each year, although fishing pressure is down considerably (55%) from what it was in the late 1960s.

9. Dramatic changes in fish assemblages occurred after the 1993 flood. The watershed was invaded by a number of big river fishes (as noted under point 4 above). Some indigenous species appeared to be more abundant in the lake after the flood including smallmouth buffalo, freshwater drum, and white bass. Lake Creek was flooded nearly continuously during the entire study period except during late fall and winter 1993-1994. The creek fauna has temporarily been given over to a number of lentic species formerly uncommon or not known from the creek including bowfin, common carp, buffalofishes, gizzard shad, mosquitofish, brook silverside, white bass, and bluegill.

10. A fresh dead shell of the flat floater (Anodonta suborbiculata) was found near the dam in the lake proper and the threeridge (Amblema plicata) was found in Lake Creek near the Rt. 3 bridge. Neither of these species are uncommon in Illinois.

11. The most common crayfish species taken in seines around the perimeter of the lake, and in the spillway and adjacent ditches, were dwarf crayfishes (Cambarellus shufeldtii) and the red crayfish (Procambarus clarkii). Both of these species are common residents of southern Illinois swamps. The state endangered oxbow crayfish (Orconectes lancifer) was taken on three different occasions from both the lake and the spillway. The five other crayfish species captured were previously known from southern Illinois, although not specifically from Horseshoe Lake. The shrimp (Palaemonetes kadiakensis) was abundant throughout the watershed.

12. The unique ecological and economic value of the Horseshoe Lake watershed cannot be overstated. If sedimentation rates continue unabated and nothing is done from a management perspective Illinois will lose a large element of aquatic biodiversity that has existed on the floodplain for thousands of years.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON FISHES AND MANAGEMENT RECOMMENDATIONS

Raising the water level in Horseshoe Lake to two feet [0.61 m] above its present level (i.e., 322 MSL) would in our judgement have few negative impacts on the majority of the fish fauna in the lake proper. If the lake continues to be managed for sport fishes, an increase in water level during the spring could contribute to enhanced reproductive opportunities for common carp and buffalofishes. While these species are desirable food fishes to a certain segment of the public they could be viewed as competitors of the traditional centrarchid sportfishes. Flooding of those parts of the lake that have a shallow, gently-sloping shoreline may also enhance reproductive and nesting opportunities for bluegill, redear, and largemouth bass, species that normally utilize shallow lakeshore areas for spawning.

If raising the water level in Horseshoe Lake results in a flushing of sediment over the spillway and an increase in sediment load below the spillway and into lower Lake Creek, other problems for fishes may arise. As noted earlier, the spillway and lower Lake Creek have the most diverse fish assemblage in the watershed, including endangered species. According to Smith (1979) and Page (1991) siltation is the major cause of aquatic habitat degradation in the state. Silt negatively affects many aquatic organisms and benefits only a few species that are able to tolerate the modified habitats left behind when other species die out. Silt inhibits the ability of fishes to breathe by impacting their gills and preventing effective oxygen exchange. High turbidity (i.e., silt suspended in water) for prolonged periods results in the suffocation of many aquatic organisms, plants as well as animals. Silt is unsuitable as a spawning substrate for most fishes because eggs laid in silt are unable to obtain an adequate oxygen supply. In heavily silted reaches where gravel and plants are covered with silt, reproductive success is reduced for many fishes, and they disappear after a few seasons. Increased siltation below the spillway could impact the spawning habitat of the endangered cypress minnow which apparently lays its eggs on plants (Warren and Burr 1989). In short, raising the water level in the lake could result in increased sediment loads below the spillway, but impacts need verification.

Management recommendations are as follows:

1. Because fishes are sensitive indicators of environmental quality, continued collection of data from the Horseshoe Lake region will aid in monitoring a variety of watershed-quality parameters and assist public agencies in identifiying quality habitats in need of protection.

2. Because of the number of fish and crayfish species endangered or threatened in the Horseshoe Lake watershed, monitoring programs should be established and status surveys of species on the watch list conducted.

3. Future management practices should strongly consider a fish-community approach that encompasses an entire watershed and its fauna, not just the lake and a few selected species.

4. A monitoring and assessment program should be established to document the spread and potential effects of invading species such as white perch, bighead carp, and grass carp on the native fish fauna of Horseshoe Lake.

5. The effects of silt buildup below the spillway (related to the proposed discharge protocol to remove silt) is an area of focus that warrants further study, especially since endangered species are known to be present. If a water-level regime is initiated (e.g., a drawdown or water level increase), then the fish community should be monitored in such a way that our historical data can be used as a baseline.

6. An education program for potential users of the Horseshoe Lake ecosystem could be developed to emphasize the numerous unique physical features of the area as well as the tremendous biological diversity that exists. Education in regard to responsible litter cleanup is desirable.

7. Controlled pond culture could be established for certain endangered/threatened lentic species (e.g., bantam sunfish, cypress minnow, and oxbow crayfish) that we predict would reproduce successfully in ponds. These stocks could be maintained for a variety of studies on reproduction, growth, and recruitment. They would also be available for introduction efforts if in the future some catastrophic event caused their extirpation. This would be particularly important if the lake were drained.

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TABLE 7-1. Fishes recorded by electrofishing from Horseshoe Lake, Alexander County, Illinois, 1993. Classification and nomenclature of fish species follows Page and Burr (1991). Each station was sampled for 60 minutes.

Family species	Spring (17 April 1993)			Summer (29 June 1993)			Fall (26 October 1993)		
	West	Dam	Northeast	West	Dam	Northeast	West	Dam	Northeast
Lepisosteidae									
1. Lepisosteus oculatus	-	-	-	1	9	3	1	1	-
2. L. platostomus	1	1	-	1	4	2	-	1	1
Amiidae									
3. Amia calva	-	-	2	1	2	-	-	6	1
Clupeidae									
4. Alosa chrysochloris	-	-	-	-	-	-	-	3	-
5. Dorosoma cepedianum	6	8	18	70	63	102	122	261	137
Hiodontidae									
6. Hiodon alosoides	-	-	-	-	-	-	-	3	-
Esocidae									
7. Esox americanus	-	-	-	-	1	-	1	-	-
Cyprinidae									
8. Cyprinus carpio	2	2	1	-	-	-	3	21	7
9. Notemigonus crysoleucas	9	1	-	24	43	3	3	-	5
10. Opsopoeodus emiliae	2	1	-	3	-	-	-	-	-
Catostomidae									
11. Ictiobus bubalus	-	-	-	-	-	-	12	23	1
12. I. cyprinellus	1	6	1	12	1	7	23	46	11

Family species	Spring (17 April 1993) West	Dam	Northeast	Summer (29 June 1993) West	Dam	Northeast	Fall (26 October 1993) West	Dam	Northeast
Ictaluridae									
13. Ictalurus punctatus	-	-	-	-	-	-	-	-	1
Aphredoderidae									
14. Aphredoderus sayanus	-	-	-	-	-	-	-	1	-
Atherinidae									
15. Labidesthes sicculus	6	15	14	1000s	1000s	1000s	4	-	3
Moronidae									
16. Morone chrysops	-	-	-	-	-	-	5	-	2
17. M. mississippiensis	-	2	34	1	2	-	-	14	1
Centrarchidae									
18. Lepomis cyanellus	-	-	-	-	-	-	-	-	1
19. L. gulosus	3	-	4	1	1	-	11	2	5
20. L. humilis	-	2	-	-	-	-	1	1	-
21. L. macrochirus	84	16	14	158	290	34	32	14	55
22. L. microlophus	34	2	17	29	62	13	22	9	23
23. Micropterus salmoides	3	-	-	25	11	1	9	5	8
24. Pomoxis annularis	4	-	8	40	18	5	6	5	5
25. P. nigromaculatus	2	1	2	-	9	-	1	2	3
Sciaenidae									
26. Aplodinotus grunniens	-	-	-	-	1	2	3	8	1

TABLE 7-2. Fishes recorded by electrofishing from Horseshoe Lake, Alexander County, Illinois, spring,1994. Classification and nomenclature of fish species follows Page and Burr (1991). Each station was sampled for 60 minutes.

Family species	Spring (13 April 1994) West	Dam	Northeast
Lepisosteidae			
1. Lepisosteus oculatus	2	3	4
2. L. platostomus	1	3	-
Amiidae			
3. Amia calva	2	4	2
Clupeidae			
4. Alosa chrysochloris	-	-	-
5. Dorosoma cepedianum	116	47	100s
Hiodontidae			
6. Hiodon alosoides	-	-	-
Esocidae			
7. Esox americanus	-	-	-
Cyprinidae			
8. Ctenopharyngodon idella	1	-	1
9. Cyprinus carpio	6	27	25
10. Notemigonus crysoleucas	3	7	11
11. Opsopoeodus emiliae	1	7	10
Catostomidae			
12. Ictiobus bubalus	32	96	12
13. I. cyprinellus	35	170	16

Family species	Spring (13 April 1994) West	Dam	Northeast
Ictaluridae			
14. Ictalurus punctatus	-	6	-
Aphredoderidae			
15. Aphredoderus sayanus	-	-	-
Atherinidae			
16. Labidesthes sicculus	7	53	44
Moronidae			
17. Morone chrysops	1	6	1
18. M. mississippiensis	-	17	36
Centrarchidae			
19. Lepomis cyanellus	-	-	-
20. L. gulosus	16	10	15
21. L. humilis	-	-	-
22. L. macrochirus	61	99	210
23. L. microlophus	46	46	115
24. Micropterus salmoides	6	3	11
25. Pomoxis annularis	3	3	9
26. P. nigromaculatus	3	4	8
Sciaenidae			
27. Aplodinotus grunniens	-	7	16

TABLE 7-3. Fishes recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, 1993. Classification and nomenclature of fish species follows Page and Burr (1991).

Family species	Spring (April & May)				Summer (June - September)				Fall (October & November)				
	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Post-flood Pools
Polyodontidae													
1. Polyodon spathula	-	-	-	-	-	-	-	-	-	-	-	-	1
Lepisosteidae													
2. Lepisosteus oculatus	-	-	-	-	-	2	-	-	-	-	-	-	-
3. L. platostomus	-	1	-	1	-	4	-	3	-	-	-	-	-
Amiidae													
4. Amia calva	-	-	1	-	-	-	-	-	-	-	5	-	-
Clupeidae													
5. Alosa chrysochloris	-	-	-	-	-	-	1	-	-	-	-	-	-
6. Dorosoma cepedianum	-	-	-	-	100	56	1	6	-	137	55	9	1
Cyprinidae													
7. Ctenopharyngodon idella	-	4	-	-	-	-	-	-	-	-	-	-	-
8. Cyprinella lutrensis	-	1	-	25	-	-	-	1	29	35	4	-	54
9. Cyprinus carpio	-	-	-	-	1	2	9	10	-	2	5	65	5
10. Hybognathus hayi	-	-	-	-	-	10	-	-	-	-	-	-	-
11. H. nuchalis	-	-	-	-	-	-	-	-	2	-	-	-	-
12. Hypophthalmichthys nobilis	-	-	-	-	-	1	-	-	-	-	-	-	-

Family species	Spring (April & May)				Summer (June - September)				Fall (October & November)				
	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Post-flood Pools
13. Lythrurus fumeus	-	-	-	-	-	-	-	-	-	-	-	5	-
14. Macrhybopsis storeriana		-	-	-	-	-	-	-	-	-	-	-	1
15. Notemigonas crysoleucas	3	12	20	-	4	16	6	58	6	4	14	-	-
16. Notropis atherinoides	-	-		30	-	-	-	-	-	-	-	-	21
17. N. blennius	-	-	-	-	-	-	-	-	1	-	-	-	1
18. N. buchanani	-	-	-	-	-	-	-	-	-	-	-	-	1
19. N. volucellus	-	-	-	-	-	-	-	-	-	1	2	-	-
20. Opsopoeodus emiliae	3	8	10	4	2	-	1	-	-	2	-	-	3
21. Pimephales notatus	2	-	25	-	-	-	1	-	-	-	-	-	-
22. P. vigilax	-	-	-	-	-	-	-	-	47	-	15	-	41
Catostomidae													
23. Carpiodes carpio	-	-	-	-	-	-	-	-	-	-	1	-	18
24. C. cyprinus	-	-	-	-	-	-	-	-	-	-	7	-	8
25. Ictiobus bubalus	-	-	-	-	-	-	3	-	8	3	25	-	6
26. I. cyprinellus	-	-	-	-	-	69	1	9	1	5	3	1	2
27. I. niger	-	-	-	-	-	-	-	-	-	-	6	-	-
Ictaluridae													
28. Ameiurus melas	-	-	-	-	8	-	-	-	-	-	12	-	-
29. A. natalis	-	-	-	-	12	-	4	1	-	-	1	-	1
30. A. nebulosus	-	-	-	-	-	-	-	-	1	-	-	-	-
31. Ictalurus punctatus	-	-	-	-	-	1	-	-	1	-	-	-	1
32. Noturus gyrinus	2	-	-	-	-	-	-	-	-	-	2	-	2
Esocidae													
33. Esox americanus	1	13	-	1	1	-	4	1	-	-	-	1	-

Family species	Spring (April & May)				Summer (June - September)				Fall (October & November)				
	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Post-flood Pools
Umbridae													
34. Umbra limi	-	-	-	-	-	1	-	-	-	-	-	-	-
Aphredoderidae													
35. Aphredoderus sayanus	-	2	-	-	13	-	-	5	1	-	-	-	-
Fundulidae													
36. Fundulus notatus	16	-	-	-	5	6	1	-	11	5	1	-	-
37. F. olivaceus	-	-	3	-	-	-	-	-	-	-	-	-	-
Poeciliidae													
38. Gambusia affinis	133	50	117	100+	2	21	12	18	100+	1	88	24	1
Atherinidae													
39. Labidesthes sicculus	14	143	-	-	-	75	5	2	5	106	3	9	1
Moronidae													
40. Morone americana	-	-	-	-	-	-	-	-	-	-	-	-	4
41. M. chrysops	-	-	-	-	-	24	1	-	3	53	16	5	6
42. M. mississippiensis	-	-	-	-	-	1	-	-	2	77	-	1	7
Elassomatidae													
43. Elassoma zonatum	1	27	12	-	-	3	5	19	-	-	-	2	-

Family species	Spring (April & May)				Summer (June - September)				Fall (October & November)				
	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Lake Proper	Spill-way	Adj. Ditches	Lake Cr.	Post-flood Pools
Centrarchidae													
44. Centrarchus macropterus	-	14	9	-	8	29	5	17	1	1	-	1	2
45. Lepomis cyanellus	-	-	-	-	-	6	12	-	7	1	12	7	4
46. L. gulosus	60	6	5	1	7	1	6	2	8	-	27	3	1
47. L. humilis	34	4	2	1	-	28	-	-	57	5	28	3	17
48. L. macrochirus	232	140	111	50+	45	20	2	2	64	1	30	21	1
49. L. megalotis	-	-	-	-	1	-	-	-	3	1	-	7	1
50. L. microlophus	22	9	-	-	14	-	2	-	21	-	12	-	4
51. Micropterus salmoides	1	-	-	-	22	10	-	-	3	-	7	-	-
52. Pomoxis annularis	7	4	-	1	-	39	2	15	16	3	32	-	-
53. P. nigromaculatus	2	-	-	-	-	26	7	-	18	10	30	1	-
Percidae													
54. Etheostoma asprigene	-	-	-	-	-	1	1	23	-	-	10	2	1
55. E. chlorosomum	-	-	-	-	-	-	-	13	-	1	-	-	2
56. E. gracile	4	-	-	-	5	10	3	21	11	2	1	1	1
57. Percina caprodes	-	-	-	-	-	1	-	-	-	-	8	-	-
58. Stizostedion canadense	-	-	-	-	-	-	-	-	-	-	-	-	1
59. S. vitreum	-	-	-	-	-	-	-	-	-	-	-	-	1
Sciaenidae													
60. Aplodinotus grunniens	-	-	-	-	-	-	2	-	2	1	-	-	8

TABLE 7-4. Fishes recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, spring 1994. Classification and nomenclature of fish species follows Page and Burr (1991).

Family species	Spring (April & May) Lake Proper	Spillway	Adj. Ditches	Lake Cr.
Polyodontidae				
1. Polyodon spathula	-	-	-	-
Lepisosteidae				
2. Lepisosteus oculatus	-	-	-	-
3. L. platostomus	-	1	-	-
Amiidae				
4. Amia calva	-	-	-	-
Clupeidae				
5. Alosa chrysochloris	-	-	-	-
6. Dorosoma cepedianum	-	-	-	31
7. Dorosoma petenense	-	-	-	1
Cyprinidae				
8. Ctenopharyngodon idella	-	-	-	-
9. Cyprinella lutrensis	14	18	-	4
10. C. venusta	-	1	-	-
11. Cyprinus carpio	-	-	-	2
12. Hybognathus hayi	-	-	-	-
13. H. nuchalis	-	-	-	2
14. Hypophthalmichthys nobilis	-	-	-	-
15. Lythrurus fumeus	-	-	-	-
16. Macrhybopsis storeriana		-	-	-

Family species	Spring (April & May) Lake Proper	Spill-way	Adj. Ditches	Lake Cr.
17. Notemigonas crysoleucas	2	3	-	11
18. Notropis atherinoides	-	10	-	2
19. N. blennius	-	-	-	-
20. N. buchanani	-	-	-	-
21. N. shumardi	-	1	-	-
22. N. volucellus	-	2	-	-
23. Opsopoeodus emiliae	-	-	-	1
24. Pimephales notatus	-	-	-	-
25. P. vigilax	-	3	-	3
Catostomidae				
26. Carpiodes carpio	-	-	-	-
27. C. cyprinus	-	-	-	-
28. Ictiobus bubalus	-	1	-	3
29. I. cyprinellus	-	-	-	2
30. I. niger	-	-	-	-
Ictaluridae				
31. Ameiurus melas	6	-	-	-
32. A. natalis	-	-	-	-
33. A. nebulosus	-	-	-	-
34. Ictalurus punctatus	-	6	-	2
35. Noturus gyrinus	-	-	-	-
Esocidae				
36. Esox americanus	-	-	-	19

Family species	Spring (April & May) Lake Proper	Spill-way	Adj. Ditches	Lake Cr.
Umbridae				
37. Umbra limi	-	-	-	-
Aphredoderidae				
38. Aphredoderus sayanus	-	-	-	-
Fundulidae				
39. Fundulus notatus	1	-	-	1
40. F. olivaceus	-	-	-	-
Poeciliidae				
41. Gambusia affinis	6	-	-	8
Atherinidae				
42. Labidesthes sicculus	-	76	-	14
Moronidae				
43. Morone americana	-	-	-	-
44. M. chrysops	-	-	-	10
45. M. mississippiensis	-	-	-	-
Elassomatidae				
46. Elassoma zonatum	-	-	-	-
Centrarchidae				
47. Centrarchus macropterus	-	-	-	4
48. Lepomis cyanellus	-	-	-	18

Family species	Spring (April & May) Lake Proper	Spill-way	Adj. Ditches	Lake Cr.
49. L. gulosus	1	-	-	9
50. L. humilis	3	7	-	12
51. L. macrochirus	77	4	-	84
52. L. megalotis	2	-	-	2
53. L. microlophus	11	3	-	3
54. Micropterus salmoides	-	-	-	4
55. Pomoxis annularis	-	27	-	3
56. P. nigromaculatus	-	29	-	3
Percidae				
57. Etheostoma asprigene	-	3	-	2
58. E. chlorosomum	1	4	-	-
59. E. gracile	4	-	-	1
60. Percina caprodes	-	2	-	-
61. Stizostedion canadense	-	-	-	-
62. S. vitreum	-	1	-	-
Sciaenidae				
63. Aplodinotus grunniens	-	179	-	15

TABLE 7-5. Fishes recorded previously from the Horseshoe Lake region, Alexander County, Illinois, but not found during the 1993-1994 survey. Classification and nomenclature of fish species follows Page and Burr (1991).

Original Name Used	Earliest Source of Fish Record	Correct Name & Identification	Probability of Occurrence
Lepisosteidae			
1. Lepisosteus osseus	Lockhart, IDOC, 1959	Lepisosteus osseus	yes, Lake Creek & lake proper
2. Alligator gar	Price, IDOC, 1964	Atractosteus spatula	yes, lake proper & spillway
Cyprinidae			
3. Campostoma anomalum	Cummings et al. (1984)	Campostoma anomalum	yes, Lake Creek
4. Carassius auratus	Gunning (1954)	Carassius auratus	yes, lake proper & ditches
5. Notropis boops	INHS 5937	Notropis boops	yes, Lake Creek
6. Notropis chrysocephalus	Cummings et al. (1984)	Luxilus chrysocephalus	yes, Lake Creek
7. Notropis umbratilis	UMMZ 111600	Lythrurus umbratilis	yes, Lake Creek
8. Phenacobius mirabilis	Cummings et al. (1984)	Phenacobius mirabilis	yes, Lake Creek
Catostomidae			
9. chub sucker	Thompson & Bennett (1938)	Erimyzon sucetta	yes, lake proper & spillway
10. Erimyzon oblongus	Thompson & Bennett (1938)	Erimyzon oblongus	yes, Lake Creek
11. spotted sucker	Thompson & Bennett (1938)	Minytrema melanops	yes, Lake Creek
12. redhorse	Thompson & Bennett (1938)	Moxostoma erythrurum	yes, Lake Creek
Ictaluridae			
13. Ictalurus furcatus	Gunning (1954)	Ictalurus furcatus	yes, lake proper & spillway
14. Pilodictis olivaris	Gunning (1954)	Pylodictis olivaris	yes, lake proper & spillway
Centrarchidae			
15. Lepomis punctatus	SIUC 2577	Lepomis miniatus	yes, lake proper & spillway
16. Lepomis symmetricus	Burr et al. (1988)	Lepomis symmetricus	yes, spillway & ditches

TABLE 7-6 Unionid mussels found in the Horseshoe Lake area, Alexander County, Illinois. 1993-1994. Classification and nomenclature follows Cummings and Mayer (1992).

Family species	Fall (October & November)		
	Lake Proper	Spill-way	Lake Creek
Unionidae			
1. Amblema plicata			1
2. Anodonta suborbiculata	1		

TABLE 7-7. Crayfishes and shrimps (Decapoda) recorded by seining from the Horseshoe Lake area, Alexander County, Illinois, 1993. Classification and nomenclature follows Page (1985).

Family species	Spring (April & May)			Summer (June-September)				Fall (October & November)	
	Lake Proper	Spill-way	Adj. Ditches	Lake Proper	Spill-way	Adj. Ditches	Lake Creek	Lake Proper	Spill way
Palaemonidae									
1. Palaemonetes kadiakensis	100s	100s	100s	100s	100s	100s	100s	100s	100s
Cambaridae									
2. Cambarellus shufeldtii	3[a]	1[a]	5	4			4	1	
3. Procambarus clarkii	1	8	3	3					
4. Procambarus viaeviridis						1			
5. Cambarus diogenes	1								
6. Orconectes lancifer				2[b]	1[b]				
7. Orconectes virilis				1					
8. Orconectes sp.								1	

[a] Females carrying eggs on 17 April
[b] State Endangered species

TABLE 7-8. Crayfishes and shrimps (Decapoda) recorded by seining from the Horseshoe Lake area, Alexander County Illinois, spring 1994. Classification and nomenclature follows Page (1985).

Family species	Spring (April & May)		
	Lake Proper	Spill-way	Adj. Ditches
Palaemonidae			
1. Palaemonetes kadiakensis	10	65	-
Cambaridae			
2. Cambarellus shufeldtii	1	-	-
3. Procambarus clarkii	3	-	-
4. Procambarus viaeviridis	-	-	-
5. Cambarus diogenes	-	-	-
6. Orconectes lancifer	2[a]	-	-
7. Orconectes virilis	-	-	-
8. Orconectes sp.	-	-	-

[a] State Endangered Species

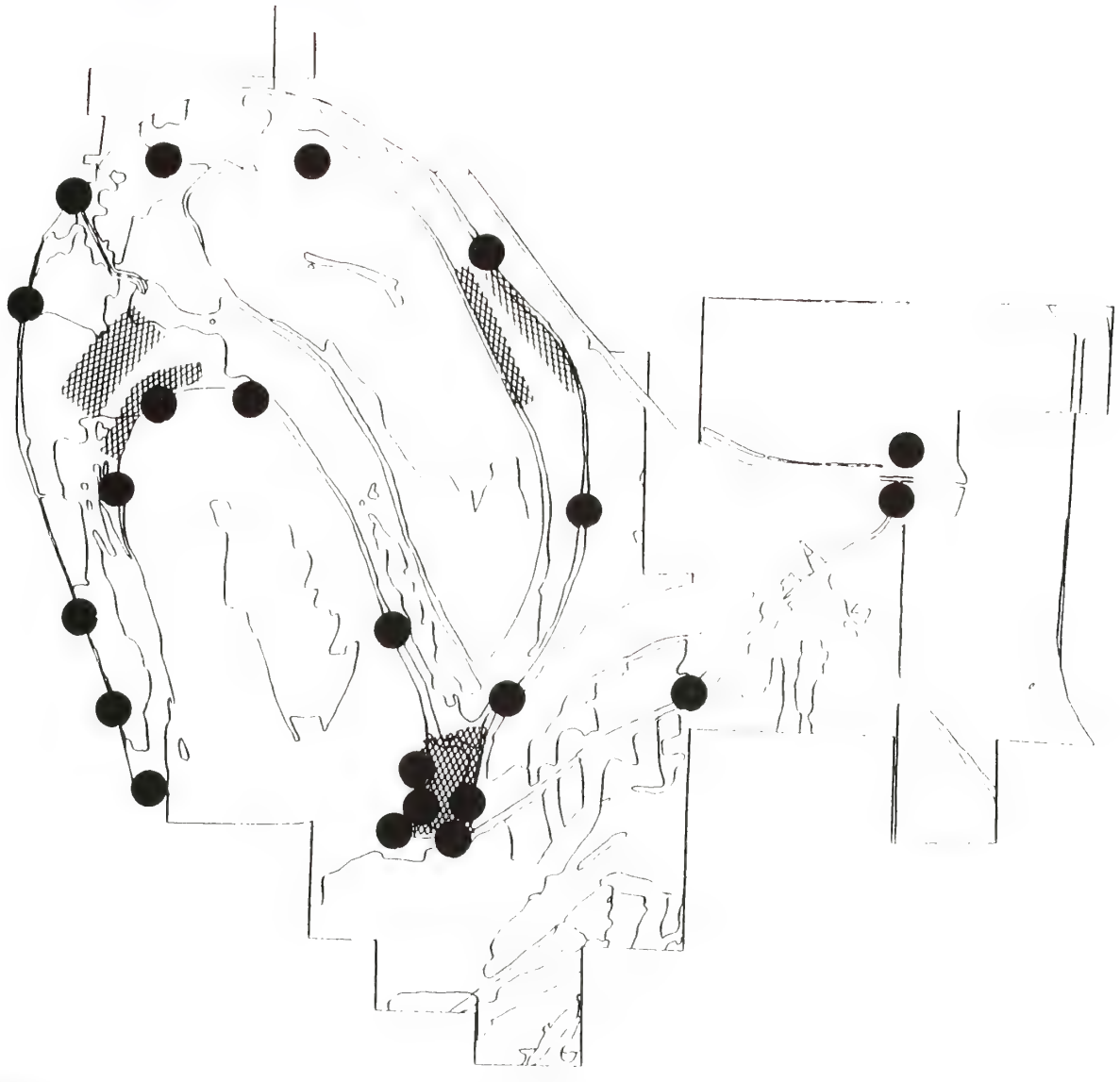

FIGURE 7-1. Sampling locations during the 1993-1994 fish surveys of the Horseshoe Lake watershed, Alexander County, Illinois. Black dots represent locations of sites sampled with seines; cross-hatched areas represent locations of sites sampled with boat electrofishing.

FIGURE 7-2. Sites of occurrence (black dots) for the State Endangered cypress minnow (Hybognathus hayi) in the Horseshoe Lake watershed, Alexander County, Illinois, 1993-1994.

FIGURE 7-3. Sites of occurrence (black dots) for the State Endangered oxbow crayfish (Orconectes lancifer) in the Horseshoe Lake watershed, Alexander County, Illinois, 1993-1994.

JOB 8: MAMMALS

George A. Feldhamer

PART ONE

SURVEY

Introduction

Literature Review

There have been no systematic, long-term sampling efforts directed specifically towards the mammalian fauna of Horseshoe Lake Conservation Area (HLCA). Several investigators have sampled on or in close proximity to the area as part of past regional survey work, however. For example, Klimstra and Scott (1956) discussed records of the rice rat (Oryzomys palustris) in southern Illinois, including samples from southern Illinois. Layne (1958) sampled at several locations 0.5-3 miles [0.8-4.8 km] NNW of Olive Branch and 2 miles [3.2 km] SE of Olive Branch as part of a distributional survey of mammals in 14 southern Illinois counties. Additional data on distribution and occurrence of 10 mammalian species from this region were given by Klimstra and Roseberry (1969). Hofmann and Gardner (1987) trapped for two nights in the roadside ditch along Promise Land Road (2.5 mile [4 km] NW Cache) and took four species of small mammals, two of which are considered threatened in Illinois. A few other investigators have sampled in and around HLCA. Much of the historical distribution and occurrence of mammals determined from earlier investigations was summarized by Hoffmeister (1989). In the mammals section of this report, records from these early works and others are noted in discussion of individual species.

Justification

Investigation of the impact of fluctuating water levels on the mammalian fauna of HLCA was directed toward small species - rodents, shrews, and bats - as larger, mammalian species are more easily observed and documented. Larger species also are more mobile and are less affected by short-term, local perturbations in water levels than small mammals might be. Nonetheless, small mammalian species are ecologically very important. Rodents, and to a lesser extent shrews, provide the primary prey base for raptors and mammalian carnivores. Bats consume large numbers of insects, are excellent environmental indicator species, and function in plant pollination and seed dispersal. Thus, patterns of occurrence, distribution, and relative abundance of these mammalian species are important determinants for community

structure and stability. The Mammals portion of this report is divided into two sections because different methods and times of sampling were used in each case. The terrestrial small mammals (rodents/shrews) are discussed in section one, and the bats in section two.

SECTION 1: RODENTS AND SHREWS

Methods

Trapping

Relative abundance of rodents and shrews was determined by trapping, primarily using standard Sherman live traps (8 x 9 x 23 cm), and secondarily using mouse-sized snap traps and pitfall traps. Three types of traps were used in an attempt to maximize the number of species taken, as different techniques yield different quantitative results (Mitchell et al. 1993). The number of traps differed at each site, depending on conditions and accessibility, but traps were operated on all sites for 3 consecutive nights. All traps were set during the afternoon and evening and checked the following morning. Sherman live traps were baited with sunflower seeds and cracked corn, and provided with Dacron bedding material. At each site, live traps were placed in a transect line. Two traps were placed in close proximity (considered a "station"), with approximately 30 feet [10 m] between stations on each transect. All individuals caught in live traps were released at the point of capture. When snap-traps were used, they were placed in the transect at alternate stations. Snap-traps were baited with peanut butter. Pitfall traps, used primarily to sample shrews (family Soricidae), consisted of plastic containers. These were approximately 7 in [17 cm] deep and 6 in [15 cm] in diameter, and were sunk flush with the ground. They were placed next to fallen logs and other natural barriers; no drift fences were used.

Study Areas

Prior to the extensive flooding of HLCA, trap sites for rodents and shrews were chosen subjectively based on general structure and type of habitat, and accessibility of the site. Six sites (A through F) were operated prior to the flood. Two additional sites (G and H) were operated after the flood. One of these (site G) was a pre-flood site that remained accessible. Thus, site E and G were the same site sampled at different times, and provided both pre- and post-flood data. The habitat characteristics at each site reflected terrestrial areas of HLCA in general, as follows (see Figure 8-1 for general locations):

Site A: Located 1.6 miles [2.6 km] SE Olive Branch (T16S, R2W, center Section 4). This was a narrow [20-30 m] forested area on the east side of the island along the edge of Horseshoe Lake. The overstory was dominated by oak (Quercus sp.) and hickory (Carya sp.), with cypress trees (Taxodium distichum) adjacent in the water. The understory was predominately greenbriar (Smilax sp.), poison ivy (Toxicodendron radicans), and grape (Vitis sp.). Traps were operated 27-29 May 1993 and included 200 Sherman live traps and 50 snap traps, extending in a transect 3750 feet [1250 m] long.

Site B: Located 3.2 miles [5.1 km] S Olive Branch (T16S, R2W, center Section 17). Was in old field habitat dominated by honeysuckle (Lonicera japonica), with interspersed woody vegetation. Traps were operated 27-29 May 1993 and included 16 Sherman live traps and 56 snap traps, in a transect extending 1080 feet [360 m].

Site C: Located 0.4 mile [0.6 km] E Miller City (T16S, R2W, center Section 20). This was in open, sparse canopy cover of pole-sized oak/hickory along a railroad track bed. Vines, poison ivy, greenbriar, grasses, and forbs made up the understory. Traps were operated from 24-26 June 1993 and included 200 Sherman live traps, in a 3000 foot [1000 m] transect.

Site D: Located 1.2 miles [1.9 km] ESE Miller City (T16S, R2W, Section 21). Was along the same railroad track bed as Site C, and began about 0.25 mile [0.4 km] east of the end of the Site C transect. Thus, habitat was the same, and traps (72 snap traps) were again operated 24-26 June 1993, along a transect 1080 feet [360 m] long.

Site E: Located 3.6 miles [5.8 km] SE Olive Branch (T16S, R2W, SW quadrant Section 11). This was along the east side of an old railroad bed, with standing water (pre-flood) along the other side. The overstory was pole-sized oaks with few mature hardwoods. Cypress trees were in the ditches immediately adjacent to the transect. Understory vegetation was sparse, and dominated by grasses and forbs. Traps, which included 120 Sherman live traps and 25 pitfall traps, were operated 8-10 July 1993 along a transect 2550 feet [850 m] long.

Site F: Located 4.4 miles [7.0 km] SE Olive Branch (T16S, R2W, SW quadrant Section 12). This was along an old road adjacent to a flooded field. There was an open canopy with scattered, mixed hardwoods. The understory included grasses and sparse to moderate honeysuckle. Eighty Sherman live traps were operated 8-10 July 1993 in a 1200 foot [400 m] long transect.

Site G: This was the same place as Site E, but was operated following extensive flooding of HLCA. One hundred Sherman live traps were set 27-29 July 1993 in a transect extending 1500 feet [500 m].

Site H: Located 4.5 miles [7.2 km] ESE Miller City (T16S, R2W, NE quadrant Section 25). This site was slightly east of HLCA, but was accessible following flooding. It was shrub habitat along a raised railroad bed. One hundred Sherman live traps were operated 27-29 July 1993 in a 1500 foot [500 m] long transect.

Data Analyses

For the rodents and shrews taken at each site, the following were determined based on trapping data:

Relative Frequency - was the number of captures of each species per total effort (that is, total captures/total trap nights). Thus, data from sites were comparable despite different number of trap nights.

Transformed Frequency Measurement - As noted by Caughley (1977:20), for single-catch traps such as Sherman live traps, each time an animal is caught, that trap is no longer functional for the remainder of that trap night. Regardless of the number of individuals in the population, the number of active traps is progressively reduced throughout the night. Transformed frequency is similar to relative frequency noted above, but gives an estimate of the number of individuals that would have been caught had the traps been capable of multiple captures. Thus, the transformed frequency measurement (x) was calculated as:

$$(1 - f) = e^{-x}$$

where f = the frequency of capture per trap for each site.

Diversity Index - The Shannon-Wiener diversity index was used as:

$$\text{small mammal diversity per site} = e^{H}$$

$$\text{with } H = -\Sigma\, p_i \log_e p_i$$

where p = the proportion of species i in the small mammal sample from each site.

Results

Trapping results from this study suggest that rodents and shrews on HLCA are somewhat depauperate both in terms of total numbers and diversity. A total of 3,057 trap nights

resulted in the capture of 234 individuals of only 6 species (Table 8-1). Snap traps accounted for only 17 captures (7.3% of the total number of individuals captured) in 390 trap nights, a 4.3% success rate. Pitfalls were used at Site E only, and were washed away when this site was inundated soon after trapping began. No other pitfalls could be placed because of the flooding and saturated ground during most of the study. No individuals were taken in pitfalls while they were operative, and trapping data from snap and live traps were combined for analyses.

Generally for small mammal surveys, average trap success is expected to be about 10%. Overall trap success in this study was somewhat low - 234/3,057 = 7.65%. Considering only pre-flood data, trap success was even lower, specifically 5.4%, compared to 16.8% post-flood success, a statistically significant difference (X^2 = 82.44, 1 df, P < 0.0001). Thus, overall trap success was inflated by a post-flood refugium effect, discussed below. Species diversity also was low. Low diversity resulted from the predominance of white-footed mice (Peromyscus leucopus) on all sites. This species made up 84.6% of total captures. The white-footed mouse was the only species taken on two sites; on two other sites there was only one capture of an individual other than Peromyscus (Table 8-1). As a result, overall small mammal diversity reflected individual site diversity and was quite low: e^H = 0.539 (see Table 8-2).

Refugium Effect

The immediate post-flood effects on small mammals can be seen on Site E/G. Before the flood, trap success on this site was 6.4%, with 28 captures of 1 species, the white-footed mouse, in 435 trap nights. Following the flood, there were 89 captures of 3 species in 300 trap nights, a trap success rate of 29.7% - again, a statistically significant increase (X^2 = 59.87, 1 df, P < 0.0001). Equally noteworthy was the number of "double captures" during post-flood trapping on this site. A Sherman live trap is designed to capture one individual at a time. As an animal enters the trap, the door closes. That individual can not leave the trap, nor can others enter it. However, post-flood on Site G there were six instances of double captures - two white-footed mice in the same trap at the same time. Double captures may occur when juveniles with low body weight enter the trap but are not heavy enough to trigger it (Feldhamer 1977), or when numbers of individuals are high in a small area and animals enter the traps simultaneously. On Site G, the individuals involved in double captures were adults, and must have entered the trap close together. This suggests an immediate post-flood "refugium effect" with limited available habitat remaining and resultant very high density.

Discussion

Threatened or Endangered Species

All species taken during this study have been reported previously from HLCA and the surrounding area. The only species considered to be threatened in the state that was taken was the rice rat (Oryzomys palustris), represented by a single capture at site H. They have been taken previously from HLCA and Alexander County (Hofmann et al. 1990). Few individuals generally are taken from any given site. They are probably more common on the study area than suggested by the single individual captured during the study, however. Hofmann and Gardner (1987), in approximately 188 trap nights along the ditch of Promised Land Road, caught 12 individual rice rats, suggesting that under some conditions they are more common.

In the midwest, rice rats reach their northern-most geographic distribution in southern Illinois. They have been reported as far north as Franklin County, but predominately are in more southern counties, including Alexander County. Thus, they are a peripheral species in Illinois. They are found primarily in habitats found throughout HLCA, permanent wetlands and swampy areas with emergent vegetation. Throughout much of the range of this species, however, suitable habitat is limited, and historically has been greatly reduced.

The state-threatened golden mouse (Ochrotomys nuttalli) also has been found on HLCA and the immediate vicinity (Feldhamer and Paine 1987), but was not taken during the study despite several sites with suitable habitat. Hofmann and Gardner (1987) caught only one golden mouse, adjacent to bottomland forest along Promised Land Road. Layne (1958) reported only one individual on each of two sites just north of Olive Branch.

Like rice rats, golden mice reach the northern most geographic limit of their distribution in southern Illinois. Historically, their distribution in the state has been associated with the Shawnee Hills physiographic region, where they are closely associated with forested habitats dominated by dense understory of greenbriar, grape, honeysuckle, and poison ivy. Like rice rats, few golden mice are taken at any site, although again they probably are more widespread in southern Illinois than previously believed (Feldhamer and Paine 1987). Their local distribution often is difficult to determine in part because they are less inclined to enter live traps than are white-footed mice (Feldhamer and Maycroft 1992). Also, trapping success often is unpredictable (Blus 1966), and they are particularly difficult to capture during

the summer (Feldhamer, unpublished data), when the current study was conducted. The single golden mouse captured by Hofmann and Gardner (1987) was taken in late March.

Small Mammal Diversity

The small mammal fauna on HLCA was somewhat depauperate based on the results of this study. Diversity may have been slightly underestimated because of possible misidentification of a few deer mice (Peromyscus maniculatus) as white-footed mice. However, Hofmann et al. (1990) reported only white-footed mice taken in 86 captures of Peromyscus from Alexander County. Hofmann and Gardner (1987) also found no P. maniculatus in their trapping along Promised Land Road. Of the four species they captured, white-footed mice made up 78% of the individuals. Additionally, considering the habitat sampled in the current study, white-footed mice were much more likely to occur than were deer mice.

It was somewhat surprising that more prairie voles were not captured during this study, especially considering the evident refugium effect noted earlier. They represented only 3.8% of the individuals captured and yet are a common species on HLCA (see Hoffmeister 1989:238). For example, prairie voles comprised 10% of the individuals captured by Hofmann and Gardner (1987). Like all microtines, the population density of prairie voles on HLCA probably is cyclic, and follows a 3-4 year cycle during which density may rise and fall by several orders of magnitude. Thus, the number of individuals captured may be influenced by the stage of the cycle to a greater extent than other factors.

Only one individual house mouse (Mus musculus) was taken. Although usually associated with human dwellings, house mice occur in a variety of natural habitats, including cropland and early successional stage fields. However, once other species become established on a site, they displace house mice (Rose et al. 1990).

Several other species of small mammals have been reported from HLCA and the immediate area (Layne 1958, Hoffmeister 1989) that were not taken in this study. Given the trapping regime and habitats sampled, the following species might be expected: pine vole (Microtus pinetorum), bog lemming (Synaptomys cooperi), and perhaps the jumping mouse (Zapus hudsonius). Pine voles are a common species throughout Illinois, and have been reported from HLCA and the immediate area (see Hoffmeister 1989:241). They usually occur along the edge of forest and old field habitat. The bog lemming also occurs on HLCA in moist stands of heavy grasses and bottomlands. However, populations are sporadic, with great yearly variations. Although not abundant, jumping mice may be more common in Illinois than previously believed.

The only records from Alexander County are from HLCA and the immediate vicinity (see Hoffmeister 1989:261). Jumping mice probably are caught more often in pitfall traps than in live traps (Mitchell et al. 1993), a factor that may have precluded their capture in this study. Many of these species may have been taken had more sites not been inundated by flood waters.

The only species of shrew taken during the study was the common southern short-tailed shrew. This species is large enough to trigger live and snap traps. Shrews known to occur on the area but not taken were: the masked shrew (Sorex cinereus), southeastern shrew (S. longirostris), and the least shrew (Cryptotis parva). The masked shrew in southern Illinois has been reported only from Alexander County, and only from the HLCA. The southeastern shrew is more widespread. Both species occur in moist habitats with sufficient ground cover. None of these shrews generally are taken in Sherman live traps, as they are too small to trigger them. Additionally, the least shrew is usually confined to drier, more upland habitats (Rose et al. 1990, Feldhamer et al. 1993), quite unlike HLCA, although there are several records of the species from the study area (Hoffmeister 1989:78). As noted, shrews are more commonly trapped in pitfalls. This type trap could be used only on one site before high water conditions washed them away and precluded there further use on other sites.

SECTION 2: BATS

Methods

Mist netting was done following the procedures of Gardner et al. (1989). Three 10-foot [3.3 m] sections of antenna poles were connected to make 30-foot [10 m] high poles with a rope pulley system to which was attached a layered "wall" of three fine-mesh mist nets, approximately 40 feet [13.3 m] long. The bottom and tops of successive nets were tied together with string to prevent gaps. The poles were assembled and nets generally were in place by 2000 hrs each night. The system was removed after it was evident that bats were no longer active. The net usually was arranged over water within canopy cover that formed a natural "chute" to funnel bats toward it. The net was checked at approximately 20 minute intervals throughout each evening. Captured bats were weighed to the nearest 0.5 g. Age (juvenile vs. adult) was determined by illumination of the epiphyseal suture of the finger joints. These are cartilaginous, translucent, and smoothly tapered in juveniles. Pregnancy was determined by an enlarged abdomen, and lactation by direct examination of the teats. Male reproduction was determined by either scrotal or nonscrotal

testes. Individuals were held in a cloth sack for approximately 0.5 hr to aid in the collection of fecal pellets for eventual determination of feeding habits by analysis of insect remains. Captured bats were then marked with a small dab of red fingernail polish between the shoulders - to determine if individuals were recaptured during the course of the study - and released. Mist netting was done on six sites throughout HLCA (Figure 8-2) on 15 nights from 7 May through 10 September 1993 (flooding and lack of access prevented mist-netting during August) as follows:

Site 1 - Located 2 miles [3.2 km] E. Miller City, northeast of spillway in a partially flooded cornfield. Better sites were flooded too deeply for access and movement wearing waders. T16S, R2W, Section 22. (UTM: 293730 m E; 4109625 m N). Date visited: 7 May 1993.

Site 2 - Located 1 mile [1.6 km] S.E Olive Branch, on north side of island in cypress trees in about 4 feet [1.3 m] of water. T16S, R2W, Section 4. (UTM: 292010 m E; 4114260 m N). Dates visited: 17 and 19 May 1993.

Site 3 - Located 2.5 miles [4.0 km] SSW Olive Branch, on west side of lake in an opening in the trees. T16S, R2W, Section 7. (UTM: 290015 m E; 4111870 m N). Dates visited: 5 and 7 June; 12 July 1993.

Site 4 - Located 1.3 miles [2.1 km] SSW Olive Branch on Black Creek (many downed trees due to recent storm). T16S, R2W, Section 6. (UTM: 290305 m E; 4114050 m N). Dates visited: 18 and 19 June 1993.

Site 5 - Located 1.25 miles [2.0 km] SSW Unity, on Lake Creek NE of the lake. T16S, R2W, Section 12. (UTM: 297160 m E; 4111790 m N). Dates visited: 27 and 28 June 1993. Set up was difficult both nights due to extensive storm and continually rising water level in the creek that eventually precluded any sampling.

Site 6 - Located 0.75 mile [1.2 km] S Olive Branch at the North Group Picnic Area on Pigeon Roost Creek, a stream corridor with many downed trees. The net was set up adjacent to a bridge until the bridge washed away. T16S, R2W, section 5. (UTM: 291015 m E; 4114720 m N). Dates visited: 4 and 5, 13 July 1993; 8 and 10 September 1993.

Results

Collection of bats varied both temporally and spatially. The 35 individual bats that were collected were taken on only 8 of the 15 nights mist-netting was done. No bats were

recaptured. While bats were taken at 4 of the 6 sites, the majority of individuals (31 of 35 = 88.6%) were collected at site #6 on Pigeon Roost Creek. There were 8 bat species collected (Table 8-3), although species richness was limited. The evening bat (Nycticeius humeralis) was the most commonly taken species (n = 20), and represented 57.1% of all captures, followed by the red bat (Lasiurus borealis; n = 10). All other species were represented by only one individual. Thus, species richness, represented by the Shannon-Wiener diversity index, was $e^H = 0.3056$. This was even lower than the diversity of the terrestrial small mammal fauna noted above.

For 32 individuals for which age could be determined, 23 (71.8%) were adults. Six adult females were either pregnant or lactating. All pregnant or lactating individuals were taken on or before 5 July. Average weight of adult female evening and red bats (mean = 14.0 g) was significantly greater than that of males (mean = 9.86 g; $t_{cal} = 5.36$, 14 df, $P < 0.0001$). The average weight of juveniles of these species was 8.2 g. All juveniles mist-netted were females (Table 8-4).

Discussion

Hoffmeister (1989) notes 14 species of bats from Illinois, although 2 of them are not resident in the state. The small-footed bat (Myotis leibii) occurs in nearby Missouri and Kentucky, but has never been recorded from Illinois. Two specimens of Mexican free-tailed bats (Tadarida brasiliensis) have been reported from Illinois (Feldhamer 1985), but this species is an accidental in the state. Thus, 12 bat species are considered to be residents in Illinois.

Although only one eastern pipistrelle (Pipistellus subflavus) was netted, an abandoned house (approximately 375 feet [125 m] SW of site #4) had 30 individual eastern pipistrelles roosting in it when checked on 19 May 1993. This is a common species on HLCA and the surrounding area. Eastern pipistrelles are commonly found hibernating in caves and mines in Alexander County and southern Illinois (Pearson 1962). During 1992, the same house had Rafinesque's big-eared bats (Plecotus rafinesqueii) in it (J. Krejca, personal communication). This state-endangered species was not taken during the current study (see below). Another species that was located on HLCA by means other than mist-netting was the little brown bat (Myotis lucifugus). This species was found roosting in the HLCA pavilion on 10 September 1993 (J. Whitaker, personal communication). Thus, including the little brown bat, and the seven species mist-netted, 8 of the 12 species of bats known to occur in Illinois were found

during this study. The only species not found were Rafinesque's big-eared bat, the gray bat (Myotis grisescens), a Federally-endangered species, the big brown bat (Eptesicus fuscus), and the silver-haired bat (Lasionycteris noctivagans).

There are recent records of the gray bat from only six counties in Illinois, and none from Alexander County, so this species was not expected. Gray bats forage over water, including reservoirs, swift-flowing rivers, and streams (Humphrey 1982). They apparently spend only brief periods of time foraging over floodplains (LaVal et al. 1977), which may partially explain their absence from the study area. Also, gray bats roost throughout the year in caves.

Although not taken during this study, Rafinesque's big-eared bat, the big brown bat, and silver-haired bat all have been reported previously from Alexander County (Hoffmeister 1989). Rafinesque's big-eared bat is restricted in Illinois to a few southern counties. There are few records of the species for summer, however. They occur in silica mines in Alexander County during the winter (Whitaker and Winter 1977). Big brown bats are one of the most common species in Illinois, and is conspicuous in urban and suburban areas around parks, buildings, and houses. They roost in both caves and mines, as well as trees, and there are several records from near the HLCA (Hoffmeister 1989:117). Silver-haired bats are resident throughout the year in southern Illinois, where they are associated with mature woodlands near water. During the winter they hibernate in silica mines in Alexander County (Smith and Parmalee 1954, Layne 1958). Their summer occurrence in the area is uncommon, however, and probably accounts for their absence during this study.

Threatened and Endangered Species

Two endangered species were mist-netted during this study. One southeastern bat (Myotis austroriparius) was taken on 5 July 1993 at site #6 (Table 8-3). Although this state-endangered species (Herkert 1992) was at one time more widely distributed throughout southern Illinois, recent survey work suggests a dramatically reduced distribution (Gardner et al. 1992). Southeastern bats are found in Illinois only in the southern-most counties. The only previous record of this species from Alexander County was 40 years ago (Smith and Parmalee 1954). They roost in mines and caves, and fly very low as they forage over water (Barbour and Davis 1969).

One Indiana bat (Myotis sodalis) was taken at site #6 on 8 September 1993. This federally-endangered species is more widely distributed throughout Illinois than the southeastern bat, but population numbers have been reduced because of a

variety of factors. It has been reported previously from Alexander County (Whitaker and Winter 1977, Gardner et al. 1990). Recent work by Gardner et al. (1990) on distribution and habitat use of Indiana bats has led to the location of several nursery colonies of the species in southern Illinois. General recovery measures for the species have been outlined (USFWS 1983). Several management recommendations that could apply to HLCA are described in Part Two of this section.

Other Species of Bats

Of the five remaining species of bats taken during this study, none are threatened or endangered. The evening bat, the most common species encountered, occurs statewide. They inhabit buildings and trees, as opposed to caves and mines. They commonly are found, as on HLCA, flying among mature forest trees and foraging in riparian habitat. As do red bats, evening bats take flight each evening earlier than most other species. Watkins (1972) suggested that in the northern part of their range, males are rare. Conversely, of 14 adult evening bats taken on HLCA during this study, 13 were males. Site #6 probably is very close to a maternity colony of evening bats based on the number of juveniles that were taken. Maternity colonies for this species have not been described; this would be an excellent opportunity for continued research at HLCA.

The red bat was the second most abundant species taken during the sampling. During the summer, Layne (1958) felt it was the most common bat in southern Illinois. They roost almost entirely in trees as opposed to caves or mines, and are one of the first species of bats to emerge every evening. Young are usually born in late May or early June. The one female taken in early June was pregnant and all four adult females taken 4-5 July were lactating. Juvenile red bats were first taken a week later on 13 July.

The little brown bat is one of the most common species in Illinois, and is often associated with old buildings. They may forage more in forested areas than some of the other species. The population ecology of this species was described by Humphrey and Cope (1976).

Keen's bat (for purposes of this report considered to be conspecific with the northern bat, Myotis septentrionalis, although see van Zyll de Jong [1985]) was represented by a single individual taken on 5 July at site #6. In summer, the species is common throughout Illinois, where it roosts in caves, mines, trees, and buildings. It has been reported from Alexander County in the winter, where it hibernates in mines (Pearson 1962, Whitaker and Winter 1977).

An individual hoary bat (Lasiurus cinereus) was taken on the final night of mist netting on 10 September. The species has not been reported previously from Alexander County (although compare Whitaker and Winter 1977, Hoffmeister 1989). There probably are very few hoary bats on HLCA during the summer when this study was conducted. It is likely that hoary bats are further north than southern Illinois in the summer, and further south in the winter.

PART TWO

ASSESSMENT OF THE IMPACT OF WATER LEVEL INCREASES ON MAMMALS AND MANAGEMENT RECOMMENDATIONS

RODENTS AND SHREWS

There are surprisingly few published studies on effects of flooding on terrestrial small mammals. As in this study, Twigg and Kay (1992) found a refugium effect when captures of house mice increased immediately following flooding in eastern Australia. Extensive flooding did not result in long-term declines in the abundance of house mice in their study. A refugium effect was also reported by Sheppe (1972) for small mammal populations on a Zambian floodplain. These populations were adapted to the unstable environment of the fluctuating seasonal water levels.

Although the long-term impact of extensive flooding can not be assessed on HLCA from the current study, previous work suggests that small mammal populations are maintained after flooding in two ways: from a few survivors in refugia and subsequent recruitment, and from rapid recolonization through dispersal from surrounding areas. Although the length and severity of flooding affects population densities, detrimental effects of flooding appear to be short-term, and small mammal populations recover former densities (Sheppe 1972, Twigg and Kay 1992). The low diversity of the small mammal fauna on HLCA probably results more from the somewhat limited habitat diversity rather than long-term effects of fluctuating water levels. Fluctuating water levels and increases in shallow or wet habitats probably benefit several species of rodents, including rice rats, and most species of shrews. Soricids are often dependent on long term moist or hydric conditions because their small size results in respiratory water loss, especially during the summer. Individuals displaced by slowly rising water probably relocate in the nearest available habitat. If not, it is doubtful that minor increases in water level have any long term effects on populations of these species.

More speculative is the impact of increased water level on certain semiaquatic species of mammals that were beyond the scope of this study. Changes in the availability of riparian habitats, channelization, dredging, and sedimentation effect habitat and food availability for species such as muskrat (Ondatra zibethicus), mink (Mustela vison), and beaver (Castor canadensis). Also, certain species of raptors that prey on muskrat could be affected. Again, there is surprisingly little literature on these aspects

BATS

The effect of minimal increases in water level, as well as severe flooding, on bats on the HLCA area again is somewhat speculative. Increased water levels actually may be positive for bats if they lead to more shallow pools and mud flats, that in turn may increase the number of insects available for foraging. Conversely, raised water levels will be negative if roost sites and maternity colonies are low enough to be flooded. This latter situation generally will not be the case except during cases of extreme high water. As noted above for terrestrial species, losses of riparian habitats and increased siltation rates impact bats by reducing roosting and foraging habitat. These factors certainly have greater long term impact on bats than changes in water levels of 0.5 feet [0.2 m] increments. More specific recommendations include:

1. Locate and identify any roost sites or winter hibernacula that may occur on HLCA. These sites should be protected from habitat manipulation, deforestation and resultant erosion and siltation. To the extent possible, they should be protected from human disturbance as well.

2. Bats on HLCA forage primarily over water, usually with surrounding adjacent vegetation. When modifications to such areas are made, such as diverting or channelizing a stream, as much riparian habitat as possible should be maintained. Preferably, a 90 foot [30 m] wide band of riparian habitat on each side should be maintained or planted.

3. Water quality of foraging habitat should be maintained. The insect fauna and the bats themselves are adversely affected by water pollution.

4. Locate, identify, and protect any nursery colonies that occur on HLCA. Efforts especially should be made to protect large, dead trees that are

potential nursery or roosting sites. Artificial bat boxes have been successful in attracting roosting bats and might be constructed on HLCA.

Roosting and maternity sites can be located and identified by mist-netting bats, as was done in this study, and attaching radiotransmitters to adult females. Roosting sites certainly occur on HLCA and probably nursery sites as well. As noted, there probably was a nursery colony of evening bats very close to site #6.

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TABLE 8-1: Terrestrial small mammals taken on seven sites on Horseshoe Lake Conservation Area from 27 May through 29 July 1993.

SITES	White-footed mouse (*Peromyscus leucopus*)	Eastern Chipmunk (*Tamias striatus*)	Southern short-tailed shrew (*Blarina carolinensis*)	Prairie vole (*Microtus ochrogaster*)	House mouse (*Mus musculus*)	Rice rat (*Oryzomys palustris*)
A	26	1	-	-	-	-
B	7	-	-	1	1	-
C	20	7	8	2	-	-
D	5	-	1	-	-	-
E	28	-	-	-	-	-
F	26	-	-	-	-	-
G	80	5	-	4	-	-
H	6	3	-	2	-	1
TOTALS	198	16	9	9	1	1

TABLE 8-2: Site-specific number of captures, number of species captured, capture frequencies, and diversity indices for small mammals taken on seven sites on Horseshoe Lake Conservation Area from May through July 1993.

Site	Number of Captures	Number of Species	Total Trapnights	Frequency of Captures	Frequency Transformed	Diversity Index
A	27	2	750	0.036	0.037	1.17
B	9	3	216	0.042	0.043	1.98
C	37	4	600	0.068	0.070	3.12
D	6	2	216	0.028	0.028	1.57
E	28	1	435	0.064	0.066	----
F	26	1	240	0.108	0.114	----
G	89	3	300	0.296	0.351	1.49
H	12	4	300	0.040	0.041	3.32

TABLE 8-3: Total number of bats mist-netted at six locations on Horseshoe Lake Conservation Area from 7 May through 10 September 1993.

SPECIES	Total Captured	Site(s) Taken	Date(s) Taken
Evening Bat (*Nycticeius humeralis*)	20	2,4,6	17 May, 19 June, 4, 5, 13 July, 8 Sept
Red Bat (*Lasiurus borealis*)	10	3,4,6	5,19 June, 4, 5, 13 July, 8 Sept
Eastern Pipistrelle (*Pipistrellus subflavus*)	1	6	13 July
Keen's Bat (*Myotis keenii*)	1	6	5 July
Southeastern Bat (*Myotis austroriparius*)	1	6	5 July
Indiana Bat (*Myotis sodalis*)	1	6	8 Sept
Hoary Bat (*Lasiurus cinereus*)	1	6	10 Sept

TABLE 8-4: Date, time, and site captured, sex, age (juvenile or adult), reproductive condition (males:nonscrotal testes = nonsc; scrotal testes = scrotal; females nonpregnant/nonlactating = non; pregnant - preg; lactating = lact), and ambient air temperature (^{O} C) at time of capture for seven species of bats mist-netted from May through September 1993 on Horseshoe Lake Conservation Area. Refer to text and Figure 8-2 for locations of site numbers.

Evening Bat	Date	Time	Site	Sex	Age	Repro	Weight	Temp
1	17 May	2145	2	M	-	-	10.5	16.5
2	19 June	2123	4	M	Ad	nonsc	08.5	24.5
3	4 July	2115	6	M	Ad	nonsc	09.0	29.0
4	4 July	2135	6	F	Juv	non	07.5	29.0
5	4 July	2150	6	-	Juv	non	-	29.0
6	4 July	2155	6	F	Juv	non	07.0	29.0
7	4 July	2202	6	F	Juv	non	08.4	29.0
8	4 July	2207	6	M	Ad	nonsc	11.0	29.0
9	4 July	2225	6	F	Juv	non	08.0	29.0
10	4 July	2308	6	M	Ad	nonsc	09.3	29.0
11	5 July	2136	6	M	Ad	nonsc	10.0	28.0
12	5 July	2200	6	M	Ad	nonsc	09.7	27.5

TABLE 8-4 (CONTINUED)

	Date	Time	Site	Sex	Age	Repro	Weight	Temp
13	5 July	2200	6	M	Ad	nonsc	09.5	27.5
14	5 July	2320	6	F	Ad	lact	11.5	27.0
15	5 July	2320	6	M	Ad	nonsc	10.5	27.0
16	13 July	2135	6	M	Ad	nonsc	09.0	28.0
17	13 July	2311	6	M	Ad	nonsc	10.0	25.0
18	8 Sept	2212	6	M	Ad	scrotal	09.5	19.0
19	8 Sept	2240	6	M	Ad	scrotal	13.0	19.0
20	8 Sept	2255	6	M	Ad	scrotal	13.5	19.0
Eastern Pipistrelle								
1	13 July	2320	6	M	Juv	nonsc	0.57	25.0
Hoary Bat								
1	10 Sept	2040	6	M	Ad	nonsc	06.0	16.0
Indiana Bat								
1	8 Sept	2131	6	M	Ad	scrotal	06.6	19.5
Keen's Bat								
1	5 July	2316	6	F	Juv	non	06.3	27.0

TABLE 8-4 (CONTINUED)

Red Bat	Date	Time	Site	Sex	Age	Repro	Weight	Temp
1	5 June	2215	3	F	Ad	preg	21.0	-
2	19 June	2147	4	F	Ad	lact	15.0	24.0
3	4 July	2115	6	M	Ad	nonsc	12.0	29.0
4	4 July	2213	6	F	Ad	lact	17.0	29.0
5	5 July	2047	6	F	Ad	lact	12.5	28.0
6	5 July	2217	6	F	Ad	lact	14.0	27.5
7	13 July	2121	6	F	Juv	non	09.0	28.0
8	13 July	2125	6	F	Juv	non	10.0	28.0
9	13 July	2151	6	F	Juv	non	07.5	28.0
10	8 Sept	2025	6	-	-	-	-	20.0
Southeastern Bat								
1	5 July	2234	6	M	Ad	nonsc	08.5	27.5

FIGURE 8-1: Locations of small mammal trapping sites operated on Horseshoe Lake conservation area from May through July 1993. See text for more precise locations and number of traps set at each site.

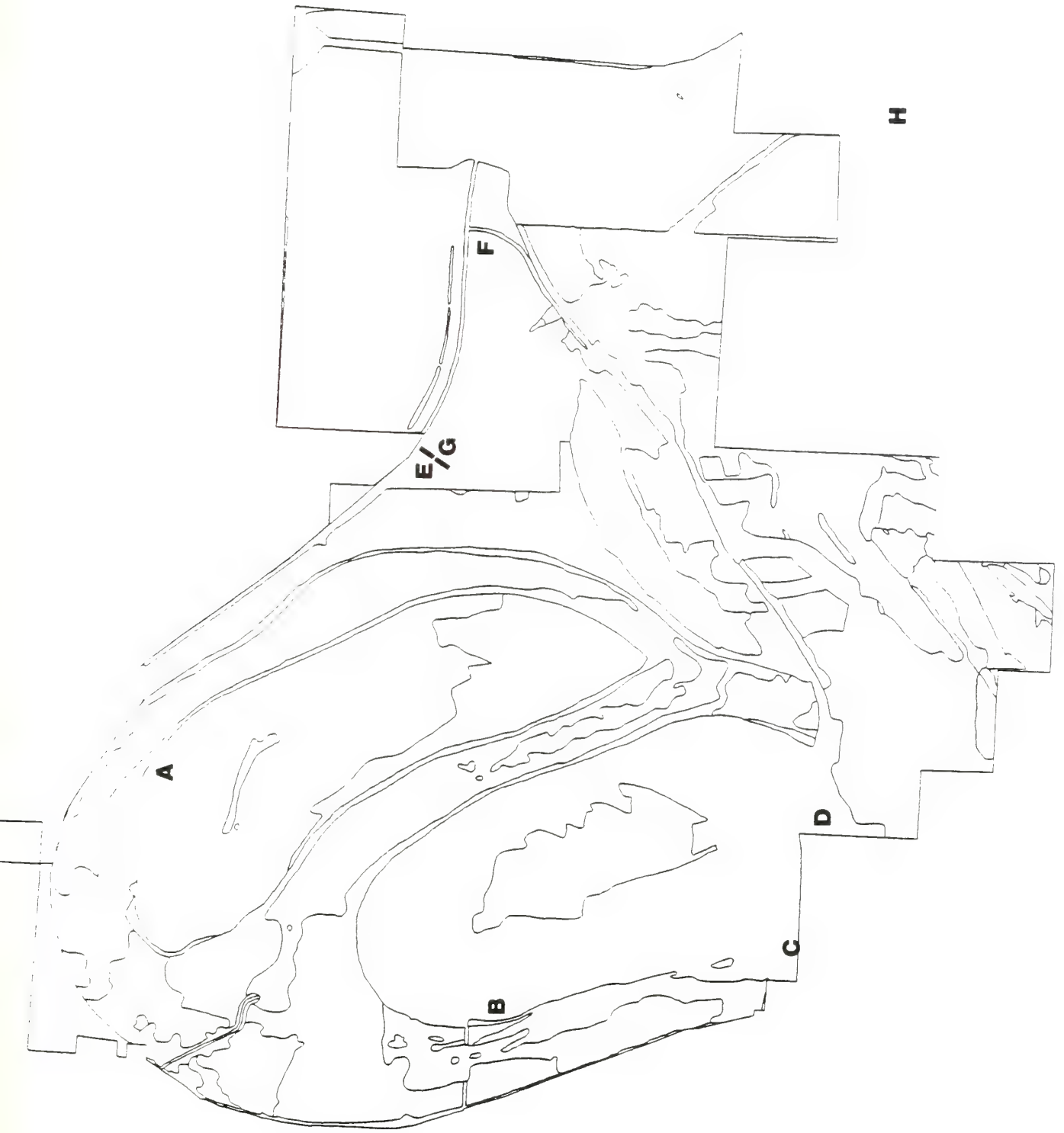
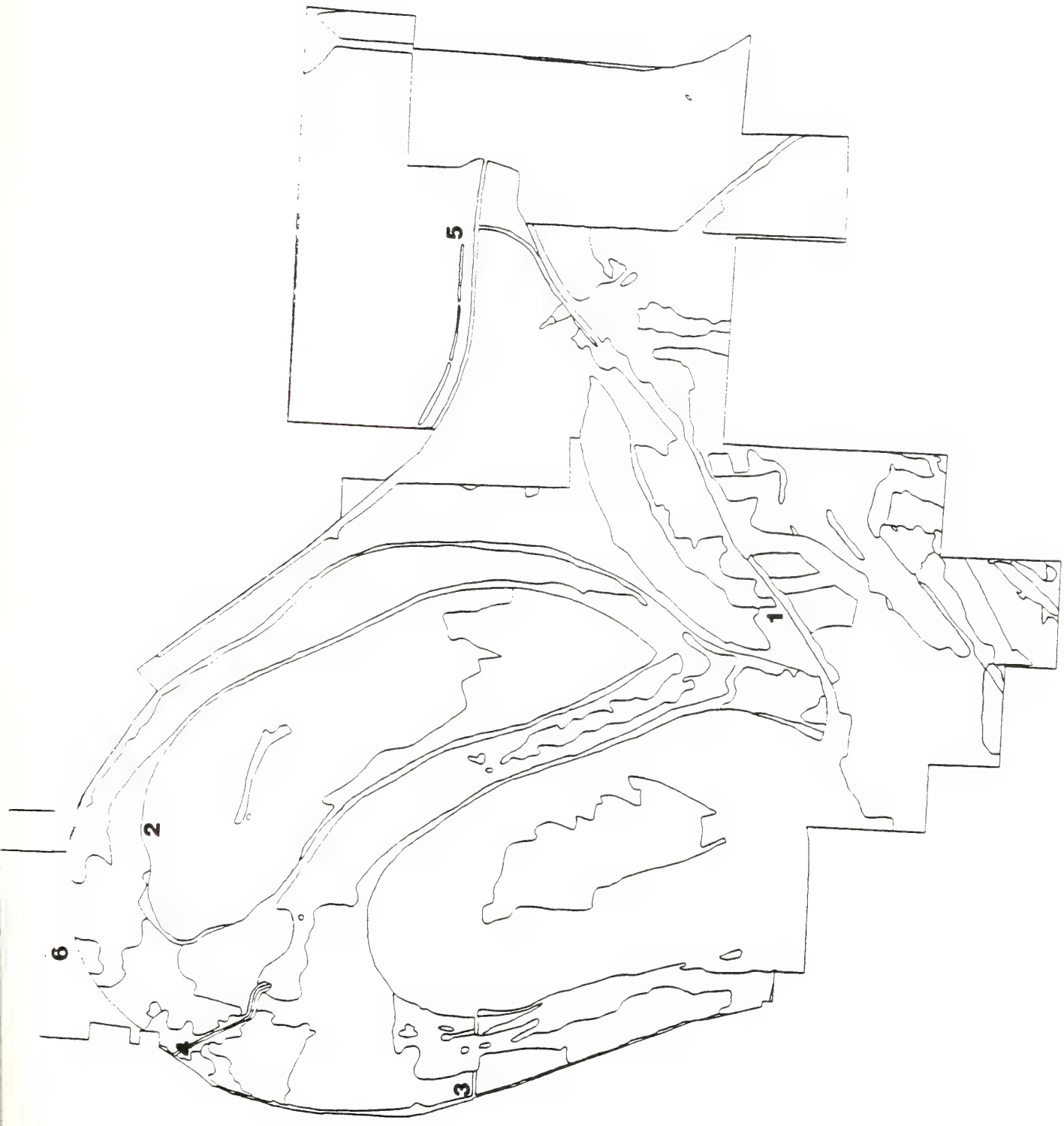

H
F
E/G
A
D
C
B

FIGURE 8-2: Location of sites on Horseshoe Conservation Area where mist-netting for bats was conducted from May through September 1993. See text for precise locations and dates of operation.


5
1
2
6
3

SUMMARY OF ASSESSMENTS OF IMPACT

All impacts will be within the present lake basin. No areas outside of the lake basin will be inundated by increasing lake levels at 6-inch increments between 322 and 324 feet MSL. Indeed, there would be no appreciable difference in impact between a 6-inch rise and a 2-foot rise. Although populations or individuals of some threatened and endangered species were recorded within the basin and would have to move because of raising the lake level, suitable habitat exists elsewhere and/or other populations exist outside of the lake basin. More details can be found in the "Part Two" sections of the individual job reports. Consequently, we do not anticipate that any species we documented on the Conservation Area would be extirpated from Horseshoe Lake Conservation Area as a result of raising the lake level. However, a potential problem worth examining further is the reduction in subsurface habitat that would be available for burrowing snakes and salamanders in the Island Woods Nature Preserve as a result of elevated ground water. We do not expect any impact on birds or mammals.

Previous stabilization of water levels and isolation of Horseshoe Lake from periodic flooding from the Mississippi and Ohio rivers may already have caused extirpation of several species from the area. Elevating the water surface by six-inch intervals to two feet is not likely to have further impact on them. Stabilization of the lake benefited the sport fishery, but with some loss of biological diversity. Periodic drawdowns would have the potential of increasing biodiversity by benefiting some of the plants and animals adapted to fluctuating environments.

Raising the water level of Horseshoe Lake will provide additional habitat for many amphibians and reptiles, fishes, and aquatic birds by increasing the volume of aquatic habitat and area of shoreline. It would also reduce the potential for oxygen depletion in the lake.

As a long-term general goal, reducing the rate of soil erosion in the Horseshoe Lake drainage and curtailing the influx of sewage would extend the life of the lake.

We are concerned over the impact of opening the gates during overflow to flush the silt if accelerated siltation occurs in Lake Creek valley. Possible negative impacts include destroying aquatic macrophytes, invertebrates, and fish spawning sites of various species, such as the cypress minnow and oxbow crayfish.

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